Draft Text on Valuation "Source Examples" Prepared by Subcommittees of the SAB Committee on Valuing the Protection of Ecological Systems and Services (C-VPESS)

INTRODUCTION

What are "source examples?"

- real examples, relevant to EPA, where a valuation has been tried, is being tried, or is planned
- source materials for C-VPESS discussion, used to frame and highlight the issues and constraints that valuations must address.
- examples used provide context for a discussion of the practical issues that EPA is likely to face in doing valuations, not to provide EPA with analysis on specific valuations.
- examples where EPA staff have provided background material and briefed SAB C-VPESS subcommittee members about valuation needs

What is the overall goal of the C-VPESS source example work?

- to help the C-VPESS develop a planned *Applications Report*, which will examine how EPA might conduct valuation studies in particular decision contexts (e.g., national rule-making, regional decisions, local decision-making) using a variety of methods.
- to help C-VPESS identify the extent to which the various methods included in the preliminary draft *Methods Report*[1], prepared by C-VPESS members, might be used by EPA, to assess their strengths and weaknesses; and to shed additional light on a number of cross-cutting issues that have been identified for inclusion in that report

When and how did the C-VPESS begin its source example work?

- At a C-VPESS planning call on February 3, 2006, committee members agreed to work in March and April on three types of source examples reflecting valuation for different purposes:
    - Valuation for national-level rule-making:
        - Focus: Economic and Environmental Benefits Analysis of the Final Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Industry Point Source Category
    - Valuation for regional decision-making involving partnerships
        - Focus: Valuation approaches for ecological protection in the context of EPA's partnerships with "Chicago Wilderness"
    - Valuation for local decision-making:

[1] on the web at http://www.epa.gov/sab/pdf/c-vpess_oct_18_2005_draft_12_methods_report.pdf) ,

- Focus: Valuation approaches for Remediation and Redevelopment at Contaminated Sites

- Subcommittee chairs worked with Agency staff, with the support of the SAB Staff Office, to develop "Overviews" of the valuation issue each subcommittee addressed.
- Subcommittees were asked to consider three questions:

1. How could EPA conduct ecological valuation as completely as possible in the specific context provided by the source example?
2. How could EPA conduct ecological valuation in other contexts that are similar to the specific context provided by the source example but differ in some key aspect such as scale, data availability, scientific uncertainty, etc.? In other words, how can the source examples provide a starting point for a more general approach to ecological valuation that would be useful to EPA?
3. Based on subcommittee discussions, how can the C-VPESS refine the discussion of cross-cutting issues currently in the October 18, 2005 draft of the Methods Report and address other cross-cutting issues identified at the December 2005 SAB Workshop, Science for Valuation of EPA's Ecological Protection Decisions and Programs?

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Valuation for National Rule Making: Subcommittee Draft Outline

SOURCE EXAMPLE FOR NATIONAL RULEMAKING: THE AQUACULTURE EFFLUENT GUIDELINES

Draft May 3, 2006

I. INTRODUCTION

A. What is the rule: Title III of the Clean Water Act (CWA) gives EPA authority to issue effluent guidelines, national standards for wastewater discharges to surface waters and publicly owned treatment works (municipal sewage treatment plants). The standards are technology-based (i.e. they are based on the performance of treatment and control technologies). They are not based on risk or impacts upon receiving waters.

The rule requires that all applicable facilities:

- Prevent discharge of drugs and pesticides that have been spilled and minimize discharges of excess feed.
- Regularly maintain production and wastewater treatment systems.
- Keep records on numbers and weights of animals, amounts of feed, and frequency of cleaning, inspections, maintenance, and repairs.
- Train staff to prevent and respond to spills and to properly operate and maintain production and wastewater treatment systems.
- Report the use of experimental animal drugs or drugs that are not used in accordance with label requirements.
- Report failure of or damage to a containment system.
- Develop, maintain, and certify a Best Management Practice plan that describes how the facility will meet the requirements.

The rule requires flow through and recirculating discharge facilities to minimize the discharge of solids such as uneaten feed, settled solids, and animal carcasses.

The rule requires open water system facilities to:

- Use active feed monitoring and management strategies to allow only the least possible uneaten feed to accumulate beneath the nets.
- Properly dispose of feed bags, packaging materials, waste rope, and netting.
- Limit as much as possible wastewater discharges resulting from the transport or harvest of the animals.
- Prevent the discharge of dead animals in the wastewater.

B. What the rule did not cover

This rule does not consider aquaculture conducted in ponds nor does it consider facilities that culture bivalve mollusks and crustaceans. These omissions are important in that a major segment of the aquaculture industry is comprised of pond raised catfish. Another growing industry involves the culture of shrimp.

Since bivalve mollusks are omitted, the risk of culturing the Asian oyster, C*rassostrea ariakensis*, for transplantation in the Chesapeake Bay is not considered. While the oysters are all supposed to be sterile, there is no guarantee that all will be. Should breeding populations become established in the bay, there is no way to remove them from the ecosystem. They would be, in effect, an exotic introduction with all of the risks that accompany such introductions

C. The purpose of this report

To examine the challenges of national rule making in the context of valuation.

Our approach—This critique will not include an analysis of how the benefits analysis for the rule was done by EPA but rather it will evaluate the environmental issues covered in the rule and to enumerate the tools that are available for valuation of the various benefits of the rule and the strengths and weaknesses of each .

This outline summarizes the conclusions reached during our two day meeting April 18-19, 2006. We started by reviewing the sequence of steps outlined in Figure 4-1 of the Draft Methods Report (October 18, 2005). These steps are:

1. (a) Identify possible ecological impacts; and (b) Identify what matters to people.
2. Identify ecological impacts that matter
3. Characterize/quantify ecological impacts
4. Characterize/quantify human consequences of ecological impacts (that is, what ecological services are affected)
5. (a) Estimate value of impacts in non-monetary terms; and (b) Estimate monetary value of impacts.

However, we found it to be useful to make two changes to this sequence: (i) we started by identifying the ecological stressors that would be potentially controlled by the rule; and (ii) we consolidated the discussion of 1 (a), 2, and 3 into a single step. The reasons for this might become clearer below.

II. ENVIRONMENTAL STRESSERS POTENTIALLY CONTROLLED BY THE RULE

Based on our review of Chapter 7, “Environmental Impacts from Aquaculture Facilities,”

(EPA, June 2004), we identified the following potential ecological stressors:

Solids;
Nutrients- Nitrogen and phosphorus;
Biochemical oxygen demand from uneaten food and feces;
Metals - from feed additives, sanitation products, and machinery and equipment;
Food additives for coloration;
Feed contaminants - mostly organochlorides;
Drugs;
Pesticides;
Pathogens;
Introduction of non-native species.

Some of these (for example, drugs, pathogens) were thought by the Agency to be very small in magnitude and not requiring further analysis. To this list we added: Habitat alteration from changes in water flows. Other impacts of aquaculture were discussed, for example, impacts on other species such as menhaden that are overfished for fish feed. But these effects were not pursued because it was judged to be unlikely that they would be substantially affected by the effluent guidelines.

III. IDENTIFY AND QUANTIFY ECOLOGICAL IMPACTS

A. FLOW ALTERATION

HAZARD: Increases in water velocity could result in scouring of bottom sediments in rivers and streams. Conversely, decreases in water velocity could increase sedimentation rates. Either would likely alter the benthic community.

CHARACTERIZE / QUANTIFY: Can be important in small streams or rivers with flow-through facilities. Ecological impacts would likely be minor on a national basis.

B. NUTRIENTS

HAZARD: Nitrogen and phosphorus can stimulate aquatic plant growth, including nuisance species such a blue green algae. In fresh water systems the limiting nutrient is phosphorus while nitrogen is limiting in marine systems. Estuarine systems generally fall in between.

Eutrophic conditions (over fertilization) from aquaculture facilities can result from the deposition of feces and waste food. Such conditions can have major ecological impacts. Hypoxic or anoxic conditions in the water column can result due to BOD and COD from decaying algae. Likewise, the benthic community can be impacted. Shading by dense algal

blooms can limit the photic zone thus affecting rooted aquatic plants.

CHARACTERIZE / QUANTIFY: There are mathematical models that can estimate dissolved oxygen concentrations resulting from anthropogenic nutrients. Likewise, there is a

vast literature on the dissolved oxygen requirements of aquatic organisms. There are federal and dissolved oxygen standards. Unfortunately, there is not a single model that will work everywhere and the models have to be calibrated for a particular water body.

C. SOLIDS (Suspended and Settleable = TSS)

HAZARD: Turbidity due to suspended solids, primarily from uneaten food and feces, can decrease the photic zone and hence affect the growth of vascular plants and algae. TSS can cause hypoxic or anoxic conditions in the water column since they have a high organic content. They can also increase water temperature as the particles absorb the sun's energy. The benthic community can be altered as the particles settle.

CHARACTERIZE / QUANTIFY TSS loads to the aquatic environment from aquaculture facilities can be quite high. For instance, the median TSS loading for 12 flow-through trout hatcheries was 100,000 lbs/yr with a maximum of near 400,000 lbs/yr. Mathematical models are available to estimate the ecological effects of TSS with the same caveats as for nutrients.

D. PATHOGENS

HAZARD: Pathogens may infect consumers of aquaculture products. This is particularly true for molluscan shellfish operations, e.g. hepatitis from consuming oysters. But since this rule excludes such facilities, the hazard to humans from aquaculture associated pathogens in likely small.

CHARACTERIZE / QUANTIFY: Not likely significant.

E. TRACE METALS (Zn, Cu, Mn, Fe)

HAZARD: Trace metals are often added to feed to insure that the essential dietary nutrients are provided. Hence feces and uneaten feed are routes to the receiving waters. Additional sources include disinfectants and machinery. Copper compounds are used extensively as antifoulants in net/pen operations. Copper is extremely toxic to aquatic organisms, especially in its free ion form. Copper sulfate is often used to control algae. Algal and vascular plant communities can be impacted leading to decreased photosynthesis.

CHARACTERIZE / QUANTIFY: There is a vast literature on the toxicity of dissolved trace metals to aquatic organisms. Cu and Zn readily sorb to sediments which decreases their biological availability to water column organisms. The impact of copper contaminated sediments depends on the characteristics and composition of the sediments in question. Factors such as organic content and grain size are important.

F. NON-NATIVE SPECIES / ESCAPEMENTS

HAZARD: The introduction of non-native species or individuals of the same species with decreased fitness could have negative impacts on aquatic ecosystems.

Among the potential impacts are: alterations of trophic structure, introductions of diseases, gene pool deterioration and habitat alterations.

CHARACTERIZE / QUANTIFY: There are numerous examples of undesirable ecological impacts due to the introduction of non-native species to aquatic systems. Utilizing these as case studies could facilitate the characterization or quantification of potential adverse biological effects due to exotic introductions. For example, the introduction zebra mussels to the Great Lakes has resulted in billions of dollars in damages due to clogged intake and cooling pipes. It has changed the trophic structure of the lakes and altered benthic habitats, etc. The introduction of carp to lakes and rivers has altered, in some cases, rooted plant communities.

G. DRUGS / PESTICIDES:

HAZARD: Drugs are used in aquaculture facilities to control diseases that can rapidly spread due to the confined nature of the animals in the facilities. The drugs may enter the receiving waters and effect non- target organisms. In addition, pesticides may be used to control parasites. Contaminants, such as PCB, chlorinated dioxins or dibenzofurans can be introduced via contaminated feed. These can also enter the receiving waters to potentially impact indigenous organisms.

CHARACTERIZE / QUANTIFY: There are numerous mathematical models available to estimate the fates and effects pharmaceuticals and persistent chemicals in surface waters.

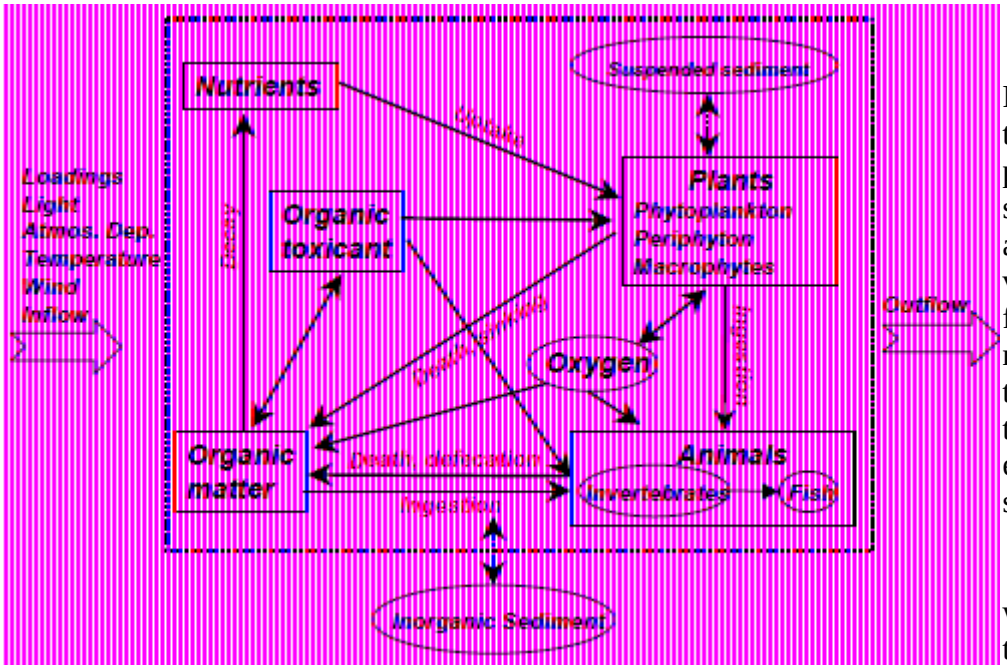
F. CONCLUSIONS: Which of the above described impacts were quantified in the Agency's analysis? Effects on dissolved oxygen, temperature, and chlorophyll a.. Why were the rest not quantified? There appear to have been two reasons:

- The lack of data on baseline stressor levels and how regulation would change these levels.
- The Agency didn't use a model capable of characterizing a wide range of ecological effects. The Agency used the QUAL2E rather than the AQUATOX model. The choice of QUAL2E appears to have been driven largely by the ability to link its outputs with the Carson and Mitchell valuation model.

QUAL2E was considered to be the "ideal tool" to model the resulting impact of the rule because of input data requirements and the various parameters to be estimated. Also the model allows various input parameters to be estimated based on literature or direct observations. The model's strength is its ability to estimate the interactions among nutrients, algal growth and dissolved oxygen. The major drawback of the model is that it is not capable of, for instance, ascertaining the impacts of TSS, metals, organics, etc. on the benthos and the resulting cascading effects on aquatic communities. There does not appear to be imbedded biological linkages and feedback loops that could allow detailed evaluations of the impact of all CAAP contaminants on the structure and function of receiving water's ecosystems.

According to the documentation for AQUATOX, "The ecosystem model AQUATOX is one of the few general ecological risk models that represents the combined environmental fate and effects of toxic organic chemicals. The model also represents conventional pollutants, such as nutrients and sediments, and considers several trophic levels, including attached and planktonic algae, submerged aquatic vegetation, several types of invertebrates, and several types of fish. It has been implemented for streams, small rivers, ponds, lakes, and reservoirs."

Visually the model treats the following ecosystem components:



For the full text we propose to show input and output variables for both models and translate these into ecosystem services.

Dra wbacks of the model. It is complex and needs lots of input data, but there is a data library that aids the process. It can take up to a week to parameterize by an experienced person. The outputs have not been tested in courts.

In the text we will attempt to estimate the cost of doing an impact assessment of an aquaculture facility using these two models versus the potential use of the outputs in valuation.

IV. IDENTIFICATION OF WHAT MATTERS TO PEOPLE

A. This item seems to have some overlap with the identification of ecological services affected by the rule. First it was noted that identification of what matters to people can not be done deductively. It requires research - by surveys, public meetings, focus groups, content analysis of public comments, and so forth. It is conceivable that relevant initiatives, referenda, or community decisions are available in some jurisdictions to get a more robust indication of the preference for cleaner water and/or the avoidance of the various risks. Where local debates over allowing fish farming have occurred, the

discourse could reveal what people care about.

Possible approaches for obtaining this information include:

- Inventory of the reasons invoked in aquaculture rulemaking in other jurisdictions (eg., state and local)
- Inventory of the concerns expressed in public hearings (perhaps with weightings based on the frequency of concerns raised): local vs. national; can be quantified through content analysis of transcripts
- Summaries of technical studies on impacts and their magnitudes
- Solicitation of expert opinion regarding the prioritization of potential hazards; can be priority lists, or can be quantified by scoring of priorities of concerns (Delphi technique, expert elicitation ala Granger Morgan, etc.)
- Focus groups and surveys of concerns (can be lists of concerns, or quantified by ranking priorities)
- Structured elicitation of values based upon multi-attribute utility theory and decision analytic techniques
- Detailed descriptions of specific degraded water bodies, improved water bodies, etc.

B. List of Possible Concerns:

- Water Body Aesthetic Quality: Turbidity, Algal blooms, Odor
- Food Supply:
  - Reduced availability of fish, shellfish
  - Reduced nutrition of available fish, shellfish
  - Reduced wildness in food flavor (e.g., wild salmon)
  - Reduced of wildness of nature as an existence value
- Biodiversity/Stability: Threats to native species (fish, mollusks, frogs, etc.)
  - [coming from both the introduction of non-native species and changes in water characteristics {temperature, chemicals, turbidity, etc}]
- Recreation: Swimming, Fishing, Boating
- Human Health: infectious diseases, impact of metals
- Jobs: Dislocation of fishers, shellfish gatherers, etc.
- Ethical concerns about the treatment of fish? (See piece by Peter Singer)

V. ESTIMATE VALUES IN NON-MONETARY TERMS

Benefits, risks, costs, and other impacts should be characterized in ways that are consistent with the best scientific methods and in ways that best enable people to understand, evaluate, and compare them. It may not always be appropriate or lead to greater understanding to monetize some impacts. In these cases, we need to rely on methods for reasonably comparing these impacts to other considerations. What is needed is some indicator of priority or importance. Four approaches for obtaining this kind of information were identified:

- Surveys of attitudes and rankings or rates;
- Mediated deliberative processes, for examples, using multi-attribute utility

models;

- Processes similar to what is used in law courts to hear and weigh evidence from experts;
- An integrated framework that uses expert judgment to assign numerical ratings or rankings to various impacts and to assign weights or values to ratings according to their relative importance to people. For an example, see Farber, Costanza, et al. (2006).

This last approach has not been discussed by the Committee before. The weighted scores for various options would be sensitive to the ratings and value weights. Relative rankings of options could be changed by changes in the ratings and weights. But if consensus could be reached on a plausible range for ratings and weights, then this approach could be used to reduce quantitative data on disparate impacts into readily understandable scores for decision makers.

VI. ESTIMATE MONETARY VALUES

Regarding monetization, the Subcommittee considered three questions. The first was: Was the approach used by the Agency to estimate the recreation benefits from the rule the best possible approach? The method used was very similar to that used by the Agency in its assessment of the CAFO rule examined by C-VPESS earlier. So many of the same comments apply here as well. The Agency used the QUAL2E water quality model to predict that changes in dissolved oxygen, temperature, and chlorophyll a that would result from implementation of the rule, used these changes to calculate the change in a water quality index, and used the Carson-Mitchell contingent valuation (CV) to value changes in the index. The principal advantage of this approach is that it was relatively quick and easy to do. Its disadvantages include:

- the CV study used was conducted more than 20 years ago and was designed for a different purpose.
- the water quality index used to translate water quality changes into units that could be valued using the CV study was highly simplified.
- any ecological impacts not captured in the water quality index but of importance to recreational users were not incorporated into the analysis.

A preferable approach would be to do site specific revealed preference (travel cost or random utility model) or stated preference analyses for a set of representative sites and to aggregate the results of these models to the 242 sites affected by the rule.

The second question was: Why didn't the Agency monetize the other ecological impacts that were identified in Section III above? As indicated in Section III above, there was a lack of data on baseline stressor levels and how regulation would change these levels, and the Agency didn't use a model capable of characterizing many of these ecological effects. Furthermore, there had not been a mapping of the ecological impacts into changes in ecological services that might be valued by standard economic methods. Some impacts, for example biodiversity, might prove difficult to value in economic terms. There have been efforts to value preservation of biodiversity using stated preference methods. These have been controversial; but carefully designed stated

preference studies might provide useful information.

The third question concerned the choice of economic model for completing the economic analysis. The logic associated with the benefits transfer undertaken for the CAAP rule relies on two strategies. Both rely on the Carson Mitchell contingent valuation survey conducted in 1982-83. Their analysis was never intended to apply to specific rivers or lakes. Rather, it related to water quality improvements in the majority of water bodies in the US for discrete changes expressed using a graphic labeled the water quality ladder. An index derived from that ladder was used as the basis for translating changes in nutrients and other pollutants into the equivalent movement "along the ladder" which connected water quality to uses of the water bodies –such as fishing or swimming. The first strategy uses a set of constants based on their estimates for discrete changes in water quality that corresponds to recreation use classifications. The second strategy uses a multivariate model expressing the willingness-to- pay responses as a function of household income and the water quality index. Based on the description in the EPA report, the second approach appears to have used one value for income for the all households. The primary distinction in estimates across states seems to have been computing the wtp for the difference between the regulatory and baseline conditions by half kilometer segments and adding them up over 30 kilometers around the affected reaches of rivers in each modeled area. There is no basis in the Carson Mitchell analysis to suggest this disaggregation has any meaning.

There are a number of alternative models that could have been used that would allow direct use of the outputs of either the AQUATOX or the QUAL2E model for ecological impacts. For example random utility models (RUM) for recreationist choice have included both physical parameters describing conditions and measures of fish availability that are in turn related to the physical attributes describing water quality conditions. These include nitrogen, phosphorus, BOD, and others. These models generally rely on actual patterns of recreation use with travel costs to estimate how the probability of taking trips to specific sites is related to travel costs and the sites' characteristics. As a rule the models are for specific areas, for example, North Carolina (Kaoru, Smith, and Liu [1995], Phanuef [2002]), Iowa (Egan[2004]), and Pennsylvania (von Haefen[1999]). There are many other examples. These specific citations are given in Phaneuf and Smith (2005).

Several possible methods could be considered for using these models in a benefit transfer task comparable to that required for the CAAP analysis. One possibility would consider the benefits per trip for a change in water quality conditions comparable to the rule's effect had it been experienced in each of the areas with an existing model linking the physical descriptors of water quality to the recreation behavior. These estimates could then be used in a summary function describing how the local choice set of recreation sites and economic characteristics of the recreationists as well as the character of the changes from existing baseline conditions influenced the estimates of unit benefits. Such a meta function could then be considered for other areas. Alternatively the models could be adapted to be directly applied to choice sets composed for affected areas –in this case the recreation behavior necessary to operationalize the model could be extracted for some of the areas from EPA's NSRE surveys for 2000 and 2004. The logic involved has two key steps:

a. translation of the effect of the rule for a set of local water quality conditions that is matched to some set of economic behavior for that area that is influenced by the water quality:

b. adaptation of an economic model of tradeoffs people would be willing to make to improve one or more aspects of the water quality for the area so that the factors –economic and ecological affexting the tradeoffs are represented in the summary

There is precedent in the literature on benefits transfer for these types of analyses.

A second class of models for evaluating stressors affected by the rule would use existing stated preference choice models for ecosystems that highlight water quality attributes. While the record here is not as extensive as it is for the revealed preference RUM models there are several candidate studies. These analyses are based on surveys that elicit respondent choices among a set of options –plans for reducing effluents or for improving water quality defined in terms of pollutants and or characteristics of ecosystems. The logic is comparable to what I described for the RUM. The effects of the rule need to be adapted to the features of each of the models and projected unit benefits derived. Then the factors affecting the benefit measure for each are with a model used in a summary analysis that can facilitate transfer to areas that do not have such models but are affected by the rule.

Our discussion of this topic concluded with one member saying that what was struck him was that the binding constraint on monetization of the approach that was utilized was the lack of quantified biological-ecological data.

VII. CROSS -CUTTING ISSUE - WHO IS APPROPRIATE TO ASSIGN ECOLOGICAL VALUES?

One issue concerns distinguishing contexts in which expert or public judgments are appropriate. Another issue, when public judgments are appropriate, is distinguishing which populations should have greater or lesser voice in assigning values. E.g., should the public be restricted to populations living in the state or communities most directly affected? Or (especially in the case of national rules) should we be getting values from more distant populations to reflect their concerns for ecological impacts?

VIII. DATA QUALITY AND UNCERTAINTY

There are four sources of uncertainty:

- model mis-specification (look at multiple models—asymmetric tests). The report (p. 8-24) talks about parameter estimation under the heading of "uncertainty in model specification," but it is broader than that. It includes what is left out.
- parameter mis-specification (can be addressed by sensitivity analysis; Monte Carlo analysis)

- poor data quality: (due to sampling of cases, poor data quality within cases: can also be addressed by sensitivity analysis); monetization through benefits transfer also reflects poor (in this case obsolete) benefits data from the Carson-Mitchell study.
- risk analysis: rather than the deterministic analysis, could they assess the probabilities of various risks, estimate the damage, but stochastically (i.e., more than a mean, the distribution, or at least the probability of big problems).

How to express uncertainty? confidence intervals; ranges; avoid spurious precision.

IX. GENERAL ISSUES

- The challenges of going from local to national (standard facilities versus standard water bodies, etc). In this section we could also discuss the pond issue, the differences in the problems for the various aquaculture species that are regionally located (trout vs. salmon vs. tilapia, etc)
- These different aquaculture approaches represent ponds, versus flowing water , versus pens all offering different technical challenges and impacts as well as being located in different parts of the country and thus considerations in rule making are actually based on local issues and techniques averaged to a national rule..
- What are other nations doing in rule making?

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Valuation for Regional Decision Making Involving Partnerships: Subcommittee Draft Outline

Introduction

The EPA regional office in Chicago requested that the CVPESS consider valuation in the context of the Chicago Wilderness (CW), in order to assist the CW with prioritization of conservation efforts, to aid the CW with implementation of its goals, as outlined in the Biodiversity Recovery Plan, in recent CW strategic planning exercises, and elsewhere.

The Chicago Wilderness consortium is an alliance of more than 180 public and private organizations that have as their common goals "to restore the region's natural communities to long term viability, enrich local residents' quality of life, and contribute to the preservation of global biodiversity." EPA Region 5 is a member of the Chicago Wilderness consortium, interested in implementing a Green Infrastructure Vision to protect biodiversity in the Chicago area and to contribute to the overall mission of EPA. US EPA has also previously sponsored the consortium, which is currently sponsored by both public and private entities, including other federal agencies.

In the final 2004 report for the Green Infrastructure Vision, the Chicago Wilderness sustainability team notes the importance of identifying "at the community/municipal scale opportunities for the identification and protection of local green infrastructure that is important to biodiversity." As the consortium moves forward, members, such as EPA Region 5, and outside entities, such as local counties, will need information about the value of land purchases and other investments for biodiversity conservation efforts, both relative to other possible investments, as well as the relative value of specific efforts, for prioritization purposes, and to justify investments to their constituents where necessary.

The Concept of "Chicago Wilderness"

The Chicago Wilderness is a well-chosen, attention-getting colloquial name for the Chicago Regional Biodiversity Council, which was started a decade ago. From the outset, biodiversity has been organization's key value, around which its work is organized. Further, the CW has consistently characterized itself as promoting and restoring historical biodiversity in the region.

The goal of Chicago Wilderness "is to protect the natural communities of the Chicago region and to restore them to long-term viability, in order to enrich the quality of life of its citizens and to contribute to the preservation of global biodiversity." This statement presents two distinct reasons for protecting natural communities. One reason to protect natural communities is because doing so may "enrich the quality of life of its citizens…." In other words, natural communities (ecosystems) have instrumental value by providing valuable goods and services to people. The term "goods and services" here is to be interpreted broadly to include such things as

the value of experiencing nature and aesthetic appreciation, as well as services that contribute to material well being.

The other reason to protect natural communities is to "contribute to the preservation of global biodiversity." It could be claimed that preserving biodiversity contributes to the welfare of people around the world, which again would be an instrumental value (perhaps the next wonder drug is lurking in some hardy species managing to survive in the polluted waters of the Calumet River). But many who argue for the preserving biodiversity claim that they do so for reasons that are wholly apart from biodiversity's contribution to human welfare, even broadly construed as above. For them, preserving biodiversity has intrinsic value. In other words, preserving biodiversity is valued as an end in itself rather than as a means to achieve another end value (e.g., human welfare).

These two distinct reasons for protecting natural communities stated by Chicago Wilderness have important consequences for discussions of values and valuation. If protection is justified by virtue of instrumental value, one can attempt to measure the value of protection by assessing the contribution of natural communities to human welfare. If biodiversity has intrinsic value, however, its protection is an end in itself. One can measure the contribution of protecting natural communities in terms of how it contributes to biodiversity, but need not necessarily measure its contribution to human welfare. The dual nature of the value of biodiversity is a particularly striking example of the tension that underlies many of the broader discussions within the committee, and in fact is represented in the very name of the committee: the Committee on the Value of Protecting Ecological Systems ***and*** Services.

Montrose Point: An Icon for the Activity of the Chicago Wilderness

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Montrose Point is a landfill point jutting out into Lake Michigan. Could Montrose Point be an icon of much of the activity of Chicago Wilderness? It seems to be a revealing case in differing ways of valuing nature. Montrose Point is an artifact; it did not exist prior to the twentieth century. It has now been managed over several decades to serve multiple needs, shifting over the decades. An earlier generation (1930s) desired there an elaborately fashioned landscape park designed with meadows and forests to intensify aesthetic experience, gardened nature on a lakefront. Later, in World War II years, the Point became an U.S. Army radar site, later it fell into disuse. Now Chicagoans have been switching to wish there a more naturally functioning environment, valuing the elemental processes that have returned, continuing recreation there, but of a different sort. Mowing has been stopped in some areas, to let native grasses return and to make the area wilder.

The Point can "point" backwards and remind Chicagoans of the pre-Chicago wild nature (of the 1830s), continuing today, beyond Midwest culture, even when Chicago enterprise has dramatically modified the landscape. The Point can "point" forward. Nature returns, overlaid on our human

artifacts. Seasonal bird migrants have discovered a left-over honeysuckle hedge, planted as by the Army as an eyesore shield, turning it into the "Magic Hedge" where urban Chicagoans can now experience the marvels of bird migration and diversity, with over 200 species sighted there. The hedge is a great place for migrants to pause before flying over the lake. An artifacted hedge comes to have an ecological function.

Environmental educators can build from the birders' delight in the spring colors of the warblers to educate Chicagoans about the trophic pyramids of avian ecology, insect ecology, and prairie ecology. Those who are not birders can start with the more picturesque and groomed elements surviving from the aborted former plans of the landscape architects, kept here and there in the park, and later learn to enjoy what they first perceived as eyesore and wild mess. Ecologists can help by interpreting these regenerated patches, re-framing events at different scales.

Is the unnatural disturbance (the Army planting the hedge) anything like a natural process (oaks appearing on aging sand dunes)? Montrose Point can offer new opportunities to witness change and dynamism in nature, its regenerative capacities. There will be opportunity for volunteers to take part in restoration biology, learn about the native grasses and shrubs they are restoring, and think about putting humans into the picture as caring for nature. There could be interpretation that sorts out transient nature (the already aging hedgerow) from persistent nature (passing and returning seasons, migration routes, returning grasses).

Is not Montrose Point an icon of the Chicago Wilderness movement? Chicago Wilderness collects fragments of nature, in a fragmented landscape; but the Chicago Wilderness movement has surprisingly revealed how many such fragments survive in the metropolitan area, totaling over 220,000 acres. Chicago Wilderness has revealed how much Chicagoans can be brought to care about their migrant birds, their wildflowers, wetlands, Lake Michigan, sand dunes, and prairies. Watching what happens on Montrose Point is not to lament that nature is gone, but to rejoice that nature is coming back.

Environmental management can facilitate this, and the results can be natural--as natural as a once-broken arm reset by physicians. Restoration and restraint will make it evident to all users that Montrose Point is a feature in which Chicagoans take pride, because they have taken great pains to plan and to protect the values they desire to have available there, foremost among which are the returning elements of naturalness. That the landfill Point did not even exist in pre-twentieth century times does not mean that the nature reasserting itself there is not authentic. The historical genesis has been interrupted, but the natural regeneration continues.

Landscape ecologists can find out whether patch dynamics continues in the city with over a hundred fragmented reserves, whether this is anything resembling what happens when a forest regenerates naturally after fragmentation by wind-blown wildfires, whether the Point succession is anything like that on the nearby Indiana

Dunes. Restoration biologists might replace the honeysuckle in the hedge with native shrubs as opportunity arises, but learn also about natural versatility and how birds switch food sources, and, with changing dynamics, switch back again. Link the Chicago-based cultural sustainability of Montrose Point with the ecological sustainability of migrants and their food sources.

Ecologists can locate the real magic in the "Magic Hedge," which, by attracting migrating birds, thereby becomes an icon attracting Chicagoans to an underlying nature lingering in, with, and under the dominant culture. This recreation is re-creating. The message coming through is of the deeper mystery, the nature seemingly at the margins but actually in the depths of human life. Hiking trails there, the ground under our feet makes us wonder about the ground of our being. In, with, and under culture, there is always this once and future nature. This is a depth value that we greatly need to behold on our landscapes. This is urban environmental ethics at its best.

Focus on Biodiversity

The CW definition of biodiversity appears very broad, and does not, as formulated, appear to provide in and of itself a principle according to which CW actions and efforts can be prioritized, without further valuation efforts.

Biodiversity – The Chicago Wilderness includes in its definition of biodiversity a discussion of ecological services and systems, including economic benefits. While emphasizing local values and community as most important, the BRP also references directly the global importance of local and regional ecological systems and services, as well as the roles of these as means, and as ends in themselves. Similarly explicit is the tie to environmental health, which is part of the mission of the US EPA. (See discussion in SAB CVPESS document Zero). Consistent with this, the first subgoal under the 3rd goal in the BRP – "**Protect globally and regionally important natural communities"** – is to **"**Identify priority areas and elements for protection based on an assessment of their contribution to conserving biodiversity at global and regional levels."

> A critical assumption in the BRP is that "A high degree of biodiversity is normally an indication of a healthy, sustainable natural community, ecosystem, or region." (BRP section 1.1.2)
>
> > "*Biodiversity* is the totality of genes, species, and ecosystems in a region. " […] "The living things with which we share the planet provide us with clean water and air, food, clothing, shelter, medicines, and aesthetic enjoyment, and they also embody our feelings of shared culture, history, and community."
>
> "In Chicago Wilderness, the value of biodiversity is not just at the global level, but most importantly for our own citizens. Natural communities and species are the basis of the region's environmental health. They provide ecological services in maintaining water quality, abating the impact of floods, supporting pollination of crops, and controlling outbreaks of pests. Equally important, biodiversity contributes immeasurably to the quality of life for the citizens of the region and to the region's long-term economic vitality. Recent polls and election results show that residents of the region strongly support protection of natural areas for the future. Only if we continue and expand upon the far-sighted conservation work of those who built the Chicago region, will we be able to pass these precious biodiversity values on to future generations."

The BRP references writings of members of the CVPESS and others in its discussion of biodiversity values, and their inclusiveness [e.g. "a review of available research indicates that many aspects of the stability, functioning, and sustainability of ecosystems depend on biodiversity (Mooney et al. 1995, Tilman 1996, Tilman et al. 1996)" – BRP chpt 2, Section 2.1.2 page 14).

Valuation in a Specific Potential Decision Context

To achieve its long- and short-term goals, focused on the restoration and conservation of biodiversity, broadly construed, the Chicago Wilderness has conducted workshops and meetings, to define implementation strategies and to prioritize among its goals. The Chicago Wilderness recognizes the potential benefits from the use of additional valuation tools, in multiple contexts. Among the possible uses of additional valuation tools identified by Chicago Wilderness members, including EPA Region 5 and others, are:

- To inform decisions on where to establish green infrastructure.
- To assess the value of preserving ground water and other ecosystem services related to clean water
- To assess the relative value of investing in different research projects, in order to prioritize among them for funding decisions.
- To assess the relative value of conventional vs alternative development efforts; valuation of the benefits to society as a whole would be useful to show how "doing something right is cheaper than doing it wrong" and where development decisions that have positive impacts on the environment might be in the financial interest of the developer. In some cases, as with storm water issues, beneficial investments seem to cost more than conventional development; valuation of the benefits to society as a whole would be useful to help construct incentive systems to address this.
- To help prioritize the acquisition of lands, for example by forest preserve districts and soil conservation districts.
- To help put a value on biodiversity in the context of local bond issues that raise the issue of open space; valuation information can help voters put a value on biodiversity to help them make voting decisions on bond issues and to inform their interactions with elected officials and local developers.

The Subcommittee chose one of these decision contexts, county open space referenda, to explore how the C-VPESS approach to valuation could be useful to support decisions to be made by members of Chicago Wilderness, including EPA Region 5.

Decision Context: County Open Space Referenda

Voters in several counties in northeastern Illinois have passed referenda authorizing bonds for Forest Preserve Districts to purchase land for the purposes of preserving open space. In November 1997, voters in DuPage County passed an open space bond for $70 million. In November 1999, voters in Kane County and Will Counties passed bond issues of $70 million in each county for open space acquisition or improvement. The citizens of McHenry County passed a $50 million bond to protect one or more watersheds. We use these successful referenda

as a way to structure our discussion of the value of protecting natural communities in a regional context. What lands should be purchased, or what management actions should be undertaken to maintain or restore natural communities, given a bond issue of $50 or $70 million? In other words, what combination of actions contributes most to the value of protecting ecological systems and services? For purposes of this exercise, we concentrate on four values from protecting natural systems: a) species conservation, b) ecological systems conservation, c) water quantity, and d) open space. For the water quantity discussion, we focus on McHenry County as this was more explicitly directed towards watersheds and less directed toward open space. We begin by discussing the provision of these four ecological endpoints and then turn to issues of monetary and non-monetary valuation.

Species Conservation and Ecological Systems Conservation

Methods developed by NatureServe for identification and prioritization of conservation actions through spatial representation and analysis of biodiversity and conservation values have been applied across multiple scales (county to regional) and geographies (from the Greater Yellowstone Ecosystem to Puerto Rico to Peru and Bolivia). They result in the spatial representation of the uniqueness and irreplaceability of biological and ecological diversity in a regional context. The methods support planning efforts to sustain biodiversity, ecological integrity and ecological services through incorporation of economics, policies and current land use condition to identify best opportunities to meet stakeholder goals. The approach is supportive of an open public process, is based on principles of conservation science, strives for complete transparency, and can provide solutions that reflect alternatives to address a single set of values or an array of alternatives that represent different stakeholder values.

- The key assumptions are that:
  - Representative biological and ecological diversity can be elaborated spatially across any region.
  - The conservation value (status and quality) of each element for conservation (species, habitat, ecosystem, service, other) and their occurrences across the landscape can be ascribed in a repeatable and consistent procedure.
  - Stakeholder need to be explicit regarding the 'elements' that they are interested in conserving, and the goals they are committed or striving to sustain.
  - The cumulative biological and ecological conservation and service values can be applied to inform practical prioritized resource management and conservation decisions and trade-offs in light of goals, policies and land uses.

- Key steps in the method:
  1. Identify the biological, ecological and ecosystem service targets
  2. Define standards that represent a viable occurrence for each target, and for valuing the relative quality of each of these occurrences.
  3. Define standards for measuring the range wide conservation status of each target.

4. Create a 'conservation value layer' for each target that represents the conservation status of the element and the viability/service value of each occurrence.
5. Create a 'conservation value summary' that represents the composite values of all conservation targets.
6. Establish the targets, goals and values for one or more stakeholder groups.
7. Map current land uses, policies, threats, economic values, and compatibilities across the project landscape.
8. Analyze and optimize spatial solutions across the project area that address stakeholder goals and provide a clear delineation of priority actions.

Chicago Wilderness has generally used the approach described above and identified biodiversity and conservation values. Below is the list of the conservation targets that the Chicago Wilderness has identified, as described in its Biodiversity Recovery Plan.

Conservation Targets in the Chicago Wilderness

Terrestrial Communities

1. Upland Forest (Dry Mesic, Mesic, Wet Mesic)
2. Floodplain Forest (Wet Mesic, Wet)
3. Flatwood (Northern, Sand)
4. Woodland (Dry Mesic, Mesic, Wet Mesic)
5. Fine Textured Soil Savanna (Dry Mesic, Mesic, Wet Mesic)
6. Sand Savanna (Dry Mesic, Mesic, Wet Mesic)
7. Fine Textured Soil Shrubland (Dry Mesic, Wet Mesic)
8. Sand Shrubland (Dry Mesic, Wet Mesic)
9. Fine Textured Soil Prairie (Dry, Mesic, Wet)
10. Sand Prairie (Dry, Mesic, Wet)
11. Gravel Prairie (Dry, Mesic)
12. Dolomite Prairie (Dry, Mesic, Wet)
13. Marsh (Basin, Streamside)
14. Bog (Graminoid, Low Shrub, Forested)
15. Fen (Calcareous Floating Mat, Graminoid, Forested)
16. Sedge Meadow
17. Panne
18. Seep and Spring (Neutral, Calcareous, Acid)
19. Cliff Communities (Eroding Bluff, Dolomite Cliff)
20. Lakeshore Communities (Beach, Foredune, High Dune)
21. Cultural Communities (Cropland, Weedy Growth, Grass, Shrub, Tree, Tree Plantations, Developed Land)

Stream Habitats

1. Headwater Streams (Continuous Flow, Intermittent Flow)
2. Low Order Streams (High Gradient, Low Gradient)
3. Mid Order Streams (High Gradient, Low Gradient)

Lake Habitats

1. Lake Michigan
2. Glacial (Kettle, Flow Through)
3. Bottomland (Vernal Pond/Pool)
4. Manmade (Naturalized, Other)

Plant Groups

1. Priority Group 1 (Globally Rare – 17 species)
2. Priority Group 2 (Great Lake Endemics – 8 species)
3. Priority Group 3 (Disturbance Dependent – 12 species)
4. Priority Group 4 (<50% EO's protected - 37 species)
5. Priority Group 5 (Reproductive challenges or unknowns - 26 species)
6. Priority Group 6 (Restricted to rare communities - 70 species)

Animal Assemblages

1. Birds (9 assemblages)
2. Reptiles and Amphibians (9 assemblages)
3. Insects (14 assemblages)

Mammals

1. Species of Concern (14 species)

Water Quantity

Described below is an approach to identifying and then quantifying impacts on water quantity from protecting or restoring one or more watershed(s) in McHenry County, Illinois, based on affected ecosystem services, as classified according to the Millennium Ecosystem Assessment (2003) and their ecosystem service providers (see Attachment 1 for general description of the Millennium Ecosystem Assessment classification). This classification offers a first approximation for identifying the possible ecological impacts.

Ecosystem Service	**Ecosystem Service Providers/Trophic Level**
Flood mitigation	Vegetation
Drought mitigation	Vegetation
Climate stability	Vegetation
Purification of water	Vegetation, soil micro-organisms, aquatic micro organisms, aquatic invertebrates -

Because the Chicago Wilderness has conducted previous studies, it is now possible to identify more site-specific ecological characteristics that are potentially important considerations in deciding among them for the purpose of maximizing available water for the protection of biodiversity and other ecological production functions. The assumption is that by protecting the watershed, land development or conversion would not occur and the natural ecological processes will prevail. Similarly, by restoring the watershed, a significant portion of these natural processes would operate within the watershed. Described in the table below are the possible ecological impacts that are possible from the protection or restoration of watersheds based on the work of the Chicago Wilderness.

Possible Ecological Impacts That Are Possible From The Protection Or Restoration Of Watersheds Based On The Work Of The Chicago Wilderness

Surface water

- Availability—more water will be retained in the watershed because there is less runoff from impervious surfaces
- Periodicity of flows—changes in the hydrograph are mitigated because precipitation will be captured in the soil and vegetation, and subsequently released more slowly
- Maintenance of minimum flows—there is a greater chance of maintaining adequate minimum flows because the of the dampening effects of intact watersheds and continuation of subsurface flows.
- Flooding—flooding in minimized because of the retention capabilities of the intact watershed

Subsurface water

- Availability for domestic and industrial use—will be increased because percolation and subsurface recharge will be enhance by natural soil surface and vegetation
- Maintenance of wetlands—those habitats that depend on the water table or subsurface flow will be enhance because natural percolation and recharge processes will be maintained

Biological systems that depend upon water quantity

- Special status species—increased persistence of those habitats that depend on increased quantities of water in the watershed and containing protected species
- Specific habitats—increased water quantity and more uniform stream flows will support regionally important ecological communities, e.g., in-stream communities, bottomland forests, wetlands and wet prairies

Effect on water quality

- Pollution dilution—increased flows will dilute concentrations of organic and inorganic pollutants
- Assimilation of biotic pollutants—increased stream flows will permit greater opportunity for the assimilation of biological materials

Identify ecological impacts that matter: Using survey techniques for both stakeholders and experts in the pertinent disciplines, officials in McHenry County could decide upon those watershed characteristics that will be most important in deciding among watersheds for the purpose of investing the $50 million. The Chicago Wilderness has in place a wide network of both stakeholders and discipline-specific experts who could be engaged in priority setting processes.

The options for selecting the ecological services and systems to be valued will be constrained by the available data. That is, data are not available to measure all the variables throughout the county. Therefore, throughout the priority-setting process, the analysis must identify those

instances in which (a) adequate data are available, (b) key data are not available but the characteristic can be approximated with surrogate measures, and (c) where key data are not available, there are no appropriate surrogates and as a result, conducting studies to obtain the data is a high priority.

There are a number of GIS data files available from McHenry County

- Major aquifers
- Aquifer within 300 and 500 ft.
- Agricultural land cover
- Land cover
- Urban land cover
- Urban open space land cover
- Water land cover
- Wetlands land cover
- County boundaries
- Conservation easements
- Forest land cover
- Streams
- Rivers
- Soils map
- Grassland cover
- Greenways
- Wetlands (National Wetlands Inventory)
- Floodplains
- Conservation areas
- County conservation districts
- State Fish and Wildlife areas

In addition, the Chicago Wilderness is developing a Stream Restoration Inventory—a database of in-stream and bio-engineering practices used in the Chicago Wilderness region to restore streams, with information about successes or failures.

In this hypothetical example, let us assume that both the stakeholders and the experts decided that the most important ecological services to be used in comparing watersheds within McHenry County were the following. The $50 million should be spent in those watersheds in which protection or restoration would

- Minimize flooding
- Maintain or increase groundwater recharge
- Maintain or increase wetland communities

Characterize/quantify ecological impacts: Quantifying the ecological impacts of each of these ecological services requires spatial analyses:

Minimize flooding: As a first approximation, historical records of flooding in the McHenry County watersheds could be examined. Those with the greatest flooding could be identified and evaluated for the potential of developing floodplain forests and wetlands for mitigating flooding. The GIS database includes layers depicting rivers, streams, wetlands, forest lands, and floodplains. The analysis could become more quantified by calculating the areas that would be flooded with incremental expansion of floodplain forests, wetlands, and intact upland forests and grasslands. In addition, the green infrastructure model could be run for representative sample areas to predict the effects of implementing various water conservation strategies.

Maintain or increase groundwater recharge: The GIS database includes maps of aquifers, aquifers at depths of 300 and 500 feet and soils maps which described run-off and percolation rates for each soil type. Thus, the watersheds could be compared in terms of potential for aquifer recharge, selecting the watersheds with the greatest potential. Then the landuse in the watersheds to determine which watersheds would have the greatest increase in recharge with the changes in land use resulting from protection or restoration (Arnold and Friedel, 2000).

Maintain or increase wetland communities: Using topographic maps and GIS data on rivers, streams, floodplains, forests, wetlands and land cover, watersheds within McHenry County could be ranked in terms of potential wetlands minus current wetlands. The areas within watersheds with the potential for expanding existing wetlands or restoring wetlands could be measured.

Characterize the quantity of human consequences of ecological impacts: Depending upon the confidence in transferring benefits of ecological services, various quantified estimations can be made. For example, *Guo et al*. (2000) measured the water flow regulation provided by various forest habitats in a Chinese watershed. If these data are transferable, or if similar data could be acquired for McHenry County, the characterization of the human consequences could be made more specific. These flow regulations can then be used to predict impacts on aquatic organisms including game fish production, on wetland and their consequent production functions such as waterfowl, fisheries, wildlife viewing, etc. (Kremen, 2005).

To decide how to invest the $50 million among the watersheds (in McHenry County), the decision-maker needs to know the additional value of protecting or restoring another unit of habitat (Dasgupta et al. 2000). Many of these responses will be non-linear, and for example, the impacts on flooding will depend upon the heights and configurations of the stream banks as well as the variability in the ecosystem service (Armsworth and Roughgarden 2003). The challenge, of course, is to optimize among several ecosystem services (DeFries et al, 2004), for example, avoidance of flooding that will damage building structures while preserving the nutrient enrichment of bottomland forests from annual flooding regimes.

Open Space

Characterizing the provision of open space, as opposed to valuing open space, is a relatively simple matter. Characterizing the provision of open space requires describing the location of

lands preserved as open space, which would define the spatial pattern and connectedness of open space, as well as the total amount of open space.

Is monetary valuation necessary?

The primary goal of Chicago Wilderness "is to protect the natural communities of the Chicago region and to restore them to long-term viability." To some extent, monetary valuation is of secondary importance given this goal. Of primary importance is to understand how various potential strategies contribute to the protection and restoration of natural communities, which is typically measured in biological terms. It also may be important to estimate the cost of various potential strategies. With an understanding of how various potential strategies contribute to the protection and restoration of natural communities and the cost of these strategies, one can undertake a cost-effectiveness analysis to see what strategies do the best job of conserving biodiversity for various levels of budget. Cost-effectiveness analysis can generate answers of how to pursue the goal of maximizing biodiversity conservation in the region given a budget constraint. For cost-effectiveness analysis, there is no need to estimate the monetary value of conserving biodiversity or of ecosystem services in general.

Monetary valuation

Monetary valuation of the protection of natural communities may provide valuable information to Chicago Wilderness, and more broadly to society at large for several reasons. First, there are multiple sources of value generated by protecting natural communities (e.g., species conservation, water quality, flood control, recreational opportunities, aesthetics, etc.). Monetary valuation provides a way to establish the relative importance of various sources of value. With "prices" or "values" attached to different ecosystem services, one can compare alternatives on the basis of the estimated overall value generated. Second, some concepts such as "biodiversity" are multi-faceted. How one makes tradeoffs between different facets of biodiversity conservation is the ultimately the same question as how one makes tradeoffs among multiple objectives. Again, establishing prices on different components of biodiversity allows for analysis of tradeoffs between components and an assessment of the overall value of particular strategies to conserve biodiversity. Finally, monetary valuation may facilitate communication about the importance of protecting and restoring natural communities in terms more readily understood by the general public.

Biodiversity Conservation: The only methods currently accepted among economists generally for valuing non-use values such as the existence value of biodiversity are stated preference methods: contingent valuation (CVM) and conjoint analysis. Chicago Wilderness could survey respondents in the Chicago area for their stated preferences for protecting biodiversity either through CVM or conjoint analysis, or it could potentially use benefits transfer to apply surveys done in other locations to biodiversity improvements in the Chicago area. The advantage of obtaining a monetary value for biodiversity improvements through CVM or conjoint analysis is

that it would permit Chicago Wilderness to calculate a total value, in a common metric, for preserving each potential parcel of land in the Chicago area and therefore allow Chicago Wilderness to look at just one number in determining which parcels of land would bring the greatest comparative value. Without using CVM or conjoint analysis, Chicago Wilderness would be able to calculate only a partial economic value for each parcel of land and would have to determine another approach for trading off between the (non-monetized) biodiversity value of each parcel of land and the other values that can be monetized.

There are several problems with using CVM to determine which parcels of land Chicago Wilderness should protect if it has a fixed budget. First, critics of CVM have raised a number of concerns regarding its accuracy and reliability. Concerns have focused on whether respondents are providing accurate values or instead expressing a general preference for biodiversity spending; whether some respondents engage in strategic or protest answers; whether respondents recognize income constraints in their answers; and the potential for income constraints. Survey techniques have improved considerably, reducing many of these concerns, but doubts still exist regarding CVM. There also is an unresolved dispute whether CVM should ask for willingness to pay (lower and perhaps more reliable answers) or willingness to accept (higher answers that may better reflect the initial legal rights).

Second, even if CVM could provide an estimate of the value that the public places for protecting various biodiversity in the Chicago area, it is less clear whether it can be used effectively to provide tradeoffs between various properties in the Chicago area. To permit accurate tradeoffs among properties, Chicago Wilderness would need to conduct surveys that estimate the value that the public places on various levels and combinations of biodiversity. How, for example, would the public feel about a tradeoff between one parcel of land that provides medium-quality habitat for a species of duck and low-quality habitat for an endangered mammal. Conjoint analysis is much better suited for this type of tradeoff analysis and would therefore seem to be the better approach in this context. Depending on the number of potential combinations of biodiversity attributes, however, even conjoint analysis might become prohibitively complex in this setting.

Finally, any effort to place a monetary value on biodiversity, whether through CVM or conjoint analysis, raises the related questions of (1) whether monetary values are commensurate with the types of values that Chicago residents attach to biodiversity, and whether the decision makers would accept monetary valuations as part of a comparative exercise. In discussing the importance of protecting biodiversity, Chicago Wilderness emphasizes that a survey of public attitudes regarding biodiversity involving Chicago focus groups found that "responsibility to future generations and a belief that nature is God's creation were the two most common reasons people cited for caring about conservation of biodiversity." (Biodiversity Recovery Plan, at 14.) CVM valuation of the bequest value of biodiversity might be consistent with measuring "responsibility to future generations," although the respondents in the focus group were

presumably thinking in moral rather than monetary terms. But neither CVM nor conjoint analysis reflect valuations based on religious stewardship.

Deliberative Valuation and Citizen Juries: Deliberative valuation exercises using citizen juries or other small focal groups might be a particularly useful means of evaluating tradeoffs among parcels of land in the Chicago Wilderness context. Under deliberative valuation, experts would work with a small group of selected individuals in the Chicago area to determine comparative values for parcels of land through a guided process of reasoned discourse. Deliberative valuation might enable participants to develop more thoughtful and informed valuations, to better tradeoff among multiple factors, and to engage in a more public-based consideration of values. Experts could use deliberative valuation either to try to come up with monetary comparisons of the values of the alternative properties or with weights that could be used to aggregate multiple layers of data.

Monetary values derived through deliberative valuations may differ considerably from traditional private values, both because of the consent-based choice rules that deliberative valuation employs and the explicitly public-regarded nature of the valuation exercise. Recent analysis suggests that deliberative valuations may aggregate individual values in a manner that systematically departs from the additive aggregation procedures of standard cost-benefit analysis. (Howarth & Wilson, 2006.)

Application of Monetary Methods to Water Quantity:

- Changes in water quantity can be valued either because there is too much (flood control) or too little water (water availability).

- Flood control: approach is to measure avoided damages with reduction in probabilities of flooding. Studies of the value of preserving wetlands for flood control have been undertaken in Illinois: Salt Creek Greenway in Illinois (Illinois Department of Conservation, 1993; USACE, 1978) and in Cook County where the estimated value of regional floodwater storage was $52,340 per acre (Forest Preserve District of Cook County Illinois, 1988).

- Water availability
    - Clean drinking water: NYC Catskills; San Antonio groundwater supply (NRC 2004); Estimates of in situ value of groundwater: Burt, 1964; Provencher, 1993; Provencher and Burt, 1994; Rubio and Casino, 1993; Tsur and Zemel, 1994.

Application of Monetary Methods to Open Space:

- Open space generates value to people for a variety of reasons including increased recreational opportunities and aesthetics. Methods for valuing open space include hedonic property price analysis, travel cost, stated preference, and voting on referenda.

- Hedonic property price analysis
    - There is a fairly large empirical literature that estimates the value of nearby open space and other environmental amenities on the value of residential property value.
    - Literature on the value of open space: The hedonic property price model has been applied to estimate the value of living close to urban parks (Kitchen and Hendon 1967, Weicher and Zeibst 1973, Hammer et al. 1974), urban wetlands (Lupi et al. 1991, Doss and Taff 1996, Mahan et al. 2000), lakes or rivers (Knetsch 1964, David 1968, Brown and Pollakowski 1977, Feather et al. 1992, Kulshreshtha and Gillies 1993, Lansford and Jones 1995, Leggett and Bockstael 2000), urban forests (Tyrvainen and Miettinen 2000), and general amenities (Smith 1978, Pogodzinski 1988, Palmquist 1992, Sivitanidou 1995). {Several recent studies to add as well…}
    - Not used by CW

- Travel cost
    - The value of recreation sites can be estimated using the travel cost method.
    - Literature on the value of open space sites:
    - Not used by CW

- Stated preference
    - Literature on the value of open space:
    - Kosobud (1998): willingness-to-pay for "wilderness recovery and extension activities" in Chicago region

- Voting on open space referenda
    - Literature on open space referenda: Kline and Wichelns 1994, Romero and Lissero 2002, Vossler et al. 2003, Vossler and Kerkvliet 2003, Schläpfer and Hanley 2003, Howell-Moroney 2004a, 2004b, Solecki et al. 2004 and Kotchen and Powers 2006, Nelson et al. 2006
    - Not used by CW, but there have been a fairly large number of open space referenda in the region

<u>Non-Monetary Valuation</u>

- -Tradeoffs of biophysical measurements/indicators
    - group processes
        - Expert driven or initiated (Denny's approach)
        - Expert and non-expert driven (mediated modeling)

        - Non-expert initiated (value-focused thinking and decision support approach)
    - surveys

- Intensity of attitudes
    - individual surveys and interviews
        - individual survey and interview design issues, including stimuli, response scales and modes
    - group processes
        - group interview design and analysis issues

Chicago Wilderness efforts to date: The CW has conducted multiple workshops over time that have carried out non-monetary valuation in the form of qualitative rankings of importance, often based on a mixture of quantitative and qualitative information, as described in the BRP and elsewhere. These workshops appear fundamental to CW valuation efforts to date.

The BRP also references and uses other valuation measures and efforts, for example the Nature Conservancy's global rarity index (BRP, Chpt 4) , and polls (e.g., "According to a 1996 poll, only two out of ten Americans had heard of the term "biological diversity." Yet, when the concept was explained, 87% indicated that "maintaining biodiversity was important to them" (Belden and Russonello1996)." – BRP page 117).

The CW carried out workshops to access the status and conservation needs with regard to natural communities in the area: Four workshops on animals: birds, mammals, reptiles and amphibians, and invertebrates. Four (consensus-building) workshops on natural communities: forested, savanna, prairie, and wetland.

In the workshops on natural communities, two indices (relative rankings) of concern were identified; the first about the amount of area remaining, the second about the quality of the remaining areas. The first identified: measures of the number of acres remaining; sufficiently large areas remaining; the percent remaining from extent before European settlement; and the amount under formal protection. The second identified assessments of quality, fragmentation, and current management efforts. These indices were combined in an overall relative ranking as well. The workshops also assessed relative biological importance" for community types, based on "species richness, numbers of endangered and threatened species, levels of species conservatism, and presence of important ecological functions (such as the role of wetlands in improving water quality in adjacent open waters)" (BRP Chpt 4, p 41), and identified visions of what the areas should look like in 50 years. The workshops judged the data as insufficient to allow quantitative assessment of natural communities.

Two different groups of scientists and land managers identified a classification scheme for aquatic communities, based on physical characteristics. Streams were assigned recovery goals

(protection, restoration, rehabilitation, and enhancement) or and lakes assigned priorities (exceptional, important, restorable, and other; based on Garrison 1994-95) in this effort. Streams were assessed using the index of biotic integrity (IBI), species or features of concern, the Macroinvertebrate Biotic Index (MBI, and abiotic indicators. The workshops also assessed threats and stressors to streams, lakes and near-shore waters of Lake Michigan.

Partnerships and collaboration: The CW now consists of over 180 members, including local, state and regional governments. Parnership and participation are included as goals and operating principles.

Chapter 8 of the Biodiversity Recovery Plan (see also Chpt 11) discusses specific roles for private property owners, local, state and regional governments, intergovernmental agencies, and federal agencies. This Chapter discusses activities each can undertake, including legal, fiscal and other approaches (e.g., planning exercises) for implementation of the BRP. Actions of the US EPA that affect biodiversity are highlighted in the discussion of its role (in Chpt 11).

Fostering public support through education and outreach is an explicit goal of the BRP. In the discussion of this goal in Chapter 10, working with schools (including universities) is emphasized, but the chapter identifies individuals, agencies and organizations as targets for outreach and involvement.

The roles or potential of private sector parties — including non-governmental organizations, business and industry, a variety of property owners, and volunteers – in biodiversity efforts are described in detail in Chapter 11 of the BRP, but only passing mention is made of their respective roles in the Chicago Wilderness (e.g., of NGOs as organizers, and of the Chicago Commercial Club in endorsing the CW).

Appendix 10 of the BRP lays out an explicit example of an inclusive planning process for the Chicago Wilderness. The example includes developing a common statement of purpose, setting up three working groups (steering, technical, and advisory committees), and working through nine planning steps, from visioning through development of inventories and assessment of alternative actions, to adopting a plan.

Cross-cutting issues

Uncertainty

Uncertainty abounds in the analysis of ecological systems. This uncertainty arises from the probabilistic behavior of ecological processes and their drivers, from the samples of ecosystem processes and structures, and from the statistical and model representations of these systems.

Establishing values for ecological goods and services requires estimates of changes in ecosystem processes and structures and in the resulting levels of services. However, estimates of ecological processes result in distributions of measurements rather than a definitive value, for example, population models, population distributions in response to perturbation, meta-population dynamics, estimates of species diversity within patches and across a gradients of all scales, rates of recovery and resilience, estimates of primary and secondary production, nutrient cycling rates, and sequestration and retention rates of carbon and minerals. Moreover, these estimates are dependent on the designated space and time scales (including corridor and edge effects) and the responses are usually non-linear and lumpy in time and space dimensions. And finally, most economic valuation techniques are relatively static, which offers an integration challenge when the uncertainty of ecological systems is captured in stochastic ecological models.

Having laid out the challenges, then the question is what can be offered constructively to the Chicago Wilderness? Two propositions guide the recommendation. First, large ecosystem models with many variables and stochastic functions are difficult to parameterize, expensive to manage and complex to interpret. Thus, a more useful initial approach is to focus on few key ecosystem services and evaluate their changes. Second, there are several possible approaches to trying to manage the uncertainty in these dynamic systems, for example, adaptive management, maxi-min rule, maximizing expected present value, option value, precautionary principle, and safe minimum standards (Polasky 2005), but the first choice is the one that maximizes learning.

The recommendation is that Chicago Wilderness begin by working through the ecological valuation sequence*[2] for one ecosystem type, perhaps floodplain forests which are a conservation priority (relatively rare but some protected areas, lack of fire is allowing trees to invade some sedge meadows and wet prairies, and more runoff has increased duration of flooding and sedimentation thus changing species composition and decreased diversity). At steps 3 and 4, insert distributions of driving variables from known samples into simple ecological production models, thus providing an estimate of the uncertainty. These results can then be used in a purposeful adaptive management approach that involves stakeholder participation in decisions informed by the stochastic output of these relatively simple production models.

(Text to be added on uncertainties and monetary/non-monetary valuation)

- [2] Ecological valuation sequence:

1. (a) Identify possible impacts to ecological goods and services, (b) identify possible impacts to ecological goods and services important to stakeholders
2. Identify impacts significant impacts to ecological goods and services
3. Characterize and quantify significant impacts to ecological goods and services
4. Characterize and quantify human consequences of ecological impact
5. (a) Estimate value of impacts on non-monetary terms (b) estimate monetary value of ecological impacts
6. Communicate results to decision makers and public

Benefits transfer

Benefits transfer methods adapt existing estimates of the tradeoffs people make for changes in ecological services so benefit measures can be used in other contexts or locations. These methods are frequently classified into three categories:

- Unit value transfers—interprets an estimate for the tradeoff people make for a change in ecological services as locally constant per unit change.
- Function transfers—replaces the unit value with a summary function that includes other values or a statistical summary of existing research.
- Preference calibration—begins by identifying the parameters of a preference relationship required to measure the tradeoff for a policy application

From an ecological perspective, the issue is the reliability of transferring one ecological value to other sites or over different spatial and time scales. This applicability of transferring benefits depends on characteristics of related resources and conditions, and on the reasonableness of using a static definition of an economic trade-off in a dynamic ecological system. Thus, there are significant uncertainties within the assumptions used in benefits transfer,

Farber, et al, (2006) have attempted to classify the benefits transfer of ecosystem services from one context to another (see below). In some cases, e.g., carbon sequestration (gas regulation) the transfer is appropriate at large spatial scales; in other cases, the processes operate at small scales but the processes are so general that they can be transferred with high confidence (e.g., value of game harvest). Some characteristics, such as genetic biodiversity (genetic resources) or spiritual values are very site-specific and thus the benefits cannot be transferred with confidence.

Gas regulation	High
Climate regulation	High
Disturbance regulation	Medium
Biological regulation	High
Water regulation	Medium
Soil retention	Medium
Waste regulation	Medium/high
Nutrient regulation	Medium
Water supply	Medium
Food	High
Raw materials	High
Genetic resources	Low
Medicinal resources	High
Ornamental resources	Medium

Recreation	Low
Aesthetics	Low
Science and education	High
Spiritual and historical	Low

The Chicago Wilderness approach could begin with the above general summary. Second, the ecological services of most significance could be identified and assessments made of the potential for transferring the benefits. Initially, this assessment could be organized by ecosystem type X stressor. For example, conversion of upland forests represents a loss of timber production which is generally transferable throughout the region. However, if the woodlands contain embedded flatwoods (fluctuating available soil water because of a perched water table or sandy soils) or are in low-lying topographic positions (more prone to loss), the benefits transfer would be reduced. Or, wildlife production from savannas is generally transferable across the region, but the biodiversity value from fine-texture soil savannas would be greater than savannas on sandy soils because more of the former have been lost to development. By aggregating these analyses, the Chicago Wilderness could create a summary table that could be the basis for assessing the economic benefits transfer.

Scale and Scope: Issues

- Geographic scale: where are the system boundaries for purposes of the study? How are interconnections that spill across system boundaries handled?

- Temporal scale: what is the length of time considered? How are effects that are more long-lasting than the period studied handled? How are values that accrue at different times aggregated discounting or some other procedure)?

- Scope: what are the relevant ecosystem services to include?

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Attachment 1
General Description of Millennium Ecosystem Classification of Ecological Services

Ecological services can be classified according to the Millennium Ecosystem Assessment (2003) list of services and their ecosystem service providers:

Service	**Ecosystem Service Providers/Trophic Level**
Aesthetic, cultural	All biodiversity
Ecosystem goods	Diverse species
UV protection	Biogeochemical cycles, micro-organisms, plants
Purification of air	Micro-organisms, plants
Flood mitigation	Vegetation
Drought mitigation	Vegetation
Climate stability	Vegetation
Pollination	Insects, birds, mammals
Pest control	Invertebrate parasitoids and predators
Purification of water	Vegetation, soil micro-organisms, aquatic micro-organisms, aquatic invertebrates
Detoxification and decomposition of wastes -	Leaf litter and soil invertebrates, soil micro organisms, aquatic micro-organisms
Soil generation and soil fertility -	Leaf litter and soil invertebrates, soil micro organisms, nitrogen-fixing plants, plant and animal production of waste products
Seed dispersal	Ants, birds and mammals

Another description of ecosystem functions and services is provided by Farber, et al, (2006), Table I, in which the functions, structures and services are classified as (a) supportive functions and structures, (b) regulating services, (c) provisioning services, and (d) cultural services.

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Valuation for Local Decision Making : Subcommittee Draft Outline

Remediation and Redevelopment at Contaminated Sites Source Example
Table of Contents for Draft Subcommittee Report

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1. Introduction

A key decision-making area for the Agency is local decisions at the level of individual properties, facilities or small watersheds. Such decisions can include permits to operate under the Clean Water and Clean Air Acts; waste disposal actions under RCRA; enhance watershed management strategies such as the development of a TMDL for a water shed or the restorations and redevelopment of a contaminated property under CERCLA or Brownfield's programs

In order to explore the potential for use of valuation methods and supporting approaches to inform such local decisions the group focused on the category of remediation and redevelopment of contaminated properties. In particular the source examples selected for this exercise were sites managed under CERCLA (i.e. Superfund).

2. Decision Context

Decisions at clean-up sites—whether they involve the worst hazardous waste sites in the United States listed on the Superfund National Priority List (NPL) and eligible for federal cleanup funds under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or whether they involve other clean-up sites (e.g., brownfields, federal facilities, leaking underground storage tanks, municipal and solid-waste sites[3])—could be enhanced by ecological valuation that could demonstrate the potential impact of ecological services obtained from site redevelopment. As well, valuation after remediation can also help EPA evaluate the ecological benefits of completed ecological action.

2a. Remediation and Redevelopment of Contaminated property

The remediation and redevelopment of contaminated property has unique technical and programmatic contextual elements. At the most general level the remediation of contaminated lands is a risk management process which has a technical core driven by engineering capacity to mitigate that risk. Although there is reason to believe that remediation and redevelopment process for contaminated property are becoming integrated for the most part bringing a property from its former state to one of new use has been traditionally a linear process that (1) identifies the source and aerial extent of the contamination, (2) estimates type(s) and degree of risk(s) associated with the contamination; (3) determines acceptable levels of contamination in various media as clean-up objectives; (4) identifies cost-effective alternative remedial technologies to achieve clean-up targets and acceptable risk levels; (5) executes remediation and (6) monitors the effectiveness of the remedial actions. Until the recent focus on "Brownfield redevelopment" came along, the actual vision for the re-use of the property was not considered until the remediation process was complete. The programmatic category of Superfund decision processes follows these steps plus adds an initial step of evaluating the site for "listing". A table (Table 1) describing the superfund process is listed in following section.

As mentioned previously the future use of contaminated properties has only recently been considered as part of the initial planning activities for contaminated property. As well, if benefits of remediation and redevelopment to human welfare and the environment have been assessed it has been a post hoc exercise and as such has suffered from being at the mercy a system driven by risk and engineering rather than by one focused on optimizing benefits and dealing with trade-offs.

2b. Superfund Process

Site-specific remediation decisions in the Superfund process follow the following general process. Steps 2-9 are steps where Remedial Project Managers in EPA Regional Offices make decisions about the status of a particular site.[4]

[3] Under the Brownfields Economic Redevelopment Initiative, Federal Facilities Restoration and Reuse Program, Underground Storage Tank Program, and Research Conservation and Recovery Act

[4] From EPA, *Superfund: Building on the Past, Looking to the Future*, April 22, 2004
"The EPA regional labs support the Superfund program by analyzing samples, conducting quality assurance, supporting field activities (field analysis to sample collection), conducting ecological and risk assessments, coordinating samples, and supporting EPA criminal investigations. From FYs 2001 through 2003, the regional laboratories conducted an average of 43,416 Superfund analyses, or 54 percent of the total analyses conducted by

Table 1: Steps in the Superfund Process

1	Discovery and Notification	Initiation: The Superfund cleanup process begins with site discovery or notification to EPA of possible releases of hazardous substances. Sites are discovered by various parties, including citizens, State agencies, and EPA Regional offices. Once discovered, sites are entered into the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS), EPA's computerized inventory of potential hazardous substance release sites (view CERCLIS Hazardous Waste Sites). EPA then evaluates the potential for a release of hazardous substances from the site through these steps in the Superfund cleanup process:
2	Assessment	Preliminary Assessment/Site Inspection (PA/SI) — investigations of site conditions
3		Hazard Ranking System Scoring — screening mechanism used to place sites on the National Priorities List
4		NPL Site Listing Process — list of the most serious sites identified for possible long-term cleanup
5		Remedial Investigation/Feasibility Study (RI/FS) — determines the nature and extent of contamination
6	Decision	Records of Decision (ROD) — explains which cleanup alternatives will be used at NPL sites
7		Remedial Design/Remedial Action (RD/RA) — preparation and implementation of plans and specifications for applying site remedies
8	Cleanup	
9	Closeout	Construction Completion — identifies completion of cleanup activities
10		Post Construction Completion — ensures that Superfund response actions provide for the long-term protection of human health and the environment. Included here are Long-Term Response Actions (LTRA), Operation and Maintenance, Institutional Controls, Five-Year Reviews, Remedy Optimization, and NPL Deletion

The Superfund Redevelopment Initiative, introduced in the early 1990s, encouraged the reuse of Superfund sites without compromising cleanup standards. EPA actively encourages partners (local governments, communities, developers, and others with stakes in redevelopment of sites) to rethink the value of Superfund sites for a variety of uses. EPA selects pilot sites and provides eligible local governments with seed money for reuse assessment and public outreach to help determine future use; develops policies to further site

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the Regions. The regional labs also conducted 1,734 field analyses in FY 2003, 1,600 of which supported the Superfund program.. (p.65)."

"The Superfund program uses IAGs to obtain a variety of services to assist with site work and other work associated with site cleanup. Examples of services that a Region may obtain through an IAG are design and construction at sites, real estate assistance (buying property or obtaining easements), and ecological risk assessments. : (p.94)

reuse; and builds partnerships with states, tribes, local governments and with other federal Agencies.

Although the agency has from more than a decade tried to stimulate optimization of the re-use value of Superfund and other contaminated properties, their efforts to document the delivered value are still rudimentary. It was noted that summaries of benefits associated with the redevelopment of superfund sites (http://www.epa.gov/superfund/programs/recycle/impacts/), when environmental benefits were identified they were only represented as qualitative statements.

Other kinds of site-specific clean-up decisions are made by federal, state, and tribal partners, developers, planners and local decision makers (city council, mayors, etc.) considering options for redevelopment and re-use of sites.

Table 2: Partnership Information for EPA Clean-up Programs

Clean-up Program	Types of Partners Involved	Website
Superfund	• Other Federal Agencies • International partnerships • Communities	http://www.epa.gov/superfund/action/ppr/index.htm http://www.epa.gov/superfund/action/community/index.htm
Brownfields Cleanup and Redevelopment	• Federal Partnerships • State and Tribal • Response Programs • International Partnerships • Association Partnerships • Organization Partnerships • Academic Partnerships • Showcase Communities	http://www.epa.gov/brownfields/partnr.htm
State, Local, and Tribal Underground Storage Tank Programs	• State Governments • Local Governments • Tribal Governments	http://www.epa.gov/swerust1/states/index.htm
Federal Facilities Restoration and Reuse	• Other Federal Agencies • State Governments • Tribal Governments • Local Governments • Community Groups • Environmental Justice Communities • Advocacy Organizations	http://www.epa.gov/fedfac/partners.htm

Solid and Municipal Waste	• Businesses • Industry • Associations • State Governments, Local Governments, the Public	http://www.epa.gov/epaoswer/osw/volunteer.htm

As part of EPA's mission to protect human health and the environment, the Agency encourages decision-makers to consider the value of protecting ecological systems and services in their decisions. EPA can better promote ecological restoration to developers, planners and local decision makers (city council, mayors, etc) if it can communicate the value of protecting ecological resources.

3. Subcommittee Approach

The purpose of this exercise was to identify and describe opportunities for inclusion of valuation methods through out the superfund process and more generally the remediation and redevelopment of contaminated properties. In general the charge for the subcommittee was to assess the following valuation issues for EPA:

- How can EPA characterize the value of ecological protection as it relates to remediation and redevelopment options[5] for contaminated sites?
- How can EPA document the value of its ecological remediation and redevelopment programs at particular sites?
- Can US EPA use valuation at specific stages in the remediation and processes to achieve a better outcome?
- How can valuations of ecological systems and services at individual sites be strategically conducted so as to maximize transfer to similar sites for future valuations

In order to progress with their analysis of the source examples the subcommittee decided to map the C-VPESS process diagram (figure 1) to the steps in the superfund process in Table 1. Then for each of the source examples the superfund process steps were reviewed and whenever possible the benefits of introducing valuation techniques were identified and discussed. For each of the superfund process steps the Subcommittee considered:

1. What ecosystem/services valuation methods and associated ecological production function data/models would best support the different process stages?
2. What specific methods (suites of methods) best apply to different ecological/social contexts and how would they improve the process at the different stages?
3. What valuation methods and assessment processes offer the greatest opportunity for transfer to other site decision and evaluations?
4. What are the major barriers to use of the respective methods in each context?

[5] Remediation is the engineering action that cleans up a site. Redevelopment means the actions that happen after cleanup – much of which is absent EPA involvement – i.e., a car dealership is built on land EPA has remediated. EPA has no role in bringing in the business; the remediation process sets the stage for it though by cleaning the land.

Valuation Process Diagram

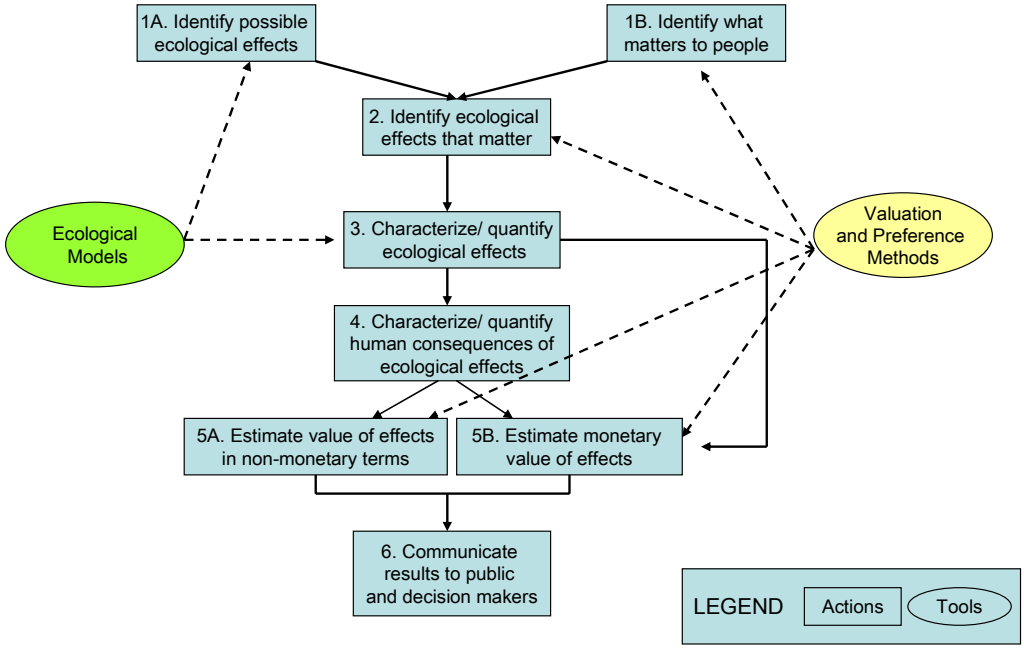


Figure 1. Value Process Diagram developed by the USEPA SAB C-VPESS

3a. Mapping C-VPESS Process to Superfund Process

The Subcommittee discussion mapped the superfund process steps (Table 1) to the steps in the C-VPESS valuation process diagram (figure 1) and discuss the possible utility of valuation techniques throughout the superfund or for that matter any contaminated land redevelopment process. Table 3 highlights the Subcommittee discussion.

Table 3. Comparison of C-VPESS Process Elements with Superfund Process Steps

Superfund Process	Process steps	C-VPESS Process
Initiation	1. Site discovery and notification; Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)	1A. Identify possible ecological effects 1B. Identify what matters to people 2. Identify ecological effects that matter This will assist in capturing the value of the site to the public
Assessment	2. Preliminary Assessment/Site Inspection (PA/SI) 3. Hazard Ranking System Scoring (HRS) 4. National Priorities List process (NPL) 5. Remedial Investigation/Feasibility Study (RI/FS)	3. Characterize ecological effects that matter 4. Characterize/quantify human consequences 5A. Estimate value of effects in non-monetary terms 5B. Estimate value of effects in monetary terms Alignment between the risk assessment and benefits assessment can be established early in the design of the risk analysis. In the problem formulation a dialogue of the linkage of risk assessment effects endpoints and the associated assessment endpoints should be tested for their ability to be linked to ecosystem services. If there is flexibility in endpoint selection then preference should be given to those linked to ecosystem service.
Decision	6. Records of Decision (ROD) 7. Remedial Design/Remedial Action (RD/RA)	Compare benefits derived from each of the alternative remedial designs This will providing the basis for balancing tradeoffs between risk and benefits of remedial actions. 6. Communicate (expected) results to public and decision-makers
Cleanup	8. Cleanup activities	
Closeout	9. Construction Completion	
Post Construction	10. Post Construction Completion Long-Term Response Actions (LTRA) Operation and Maintenance Institutional Controls Five-Year Reviews Remedy Optimization NPL Deletion	Use ecosystem services as a focus of performance measurement
Restoration/ Reuse/ Reengineering	Superfund Redevelopment Initiative (SRI)	6. Communicate (actual) results to public and decision-makers

3b. Selection of Source Examples

The Agencies Office of Solid Waste and Emergency Response (OSWER) had recently embarked on preliminary steps to improved their ability to capture the ecological benefits associated with Superfund clean-ups and the subsequent redevelopment of those sites for productive use. As part of this effort they commissioned a white paper focused on Ecosystem Services at superfund sites. The report titled *Ecosystem Services at Superfund Redevelopment Sites: Revealing the Value of Revitalized Landscapes through the integration of Ecology and Economics* (Final Report November 10, 2004) was drafted by Matthew Wilson of Spatial Informatics, LLC. This report provided an initial assessment of the expected ecosystems services that could expect to be upgraded as a result of site clean-ups and redevelopment for 3 specific sites. Wilson organized these services in a matrix that was in alignment with the ecosystem service categories put forth by the United Nations Millennium Ecosystem Assessment categories; *Regulating, Supporting, Provisioning and Cultural*. The Subcommittee felt that building from this initial Agency effort might provide it with a well grounded set of source examples as well as possible add the Agency with ideas for next steps for their efforts.

In addition to the work by Wilson (2004) the work group also evaluated the current efforts by the USEPA Region V office to compare the costs and benefits of traditional verses sustainable redevelopment processes for contaminated properties. As an example we evaluated Region V's efforts associated with a workshop focused on *Greening Milwaukee*. Although the Subcommittee was excited by the agencies efforts in this area, it also felt that this effort was a work in progress that limited our ability to work with this example. As a follow-up to this SAB effort it might be a reasonable recommendation that Region V and C-VPESS should have further contact which may help the Agency office incorporate some of the C-VPESS applications report recommendation into its work.

Ultimately the Subcommittee decided that the three source examples (see attachment A) in the Wilson (2004) report were the best basis for this evaluation. These include:

- Charles George Reclamation Trust Landfill, MA
- Avtex Fibers Site, VA
- Leviathan Mine, CA

4c. Background Document and Supplementary Information

Wilson, M. A. (2004). *Ecosystem Services at Superfund Redevelopment Sites, Revealing the Value of Revitalized Landscapes through the Integration of Ecology and Economics*. Report prepared by Spatial Informatics Group, LLC under subcontract of Systems Research and Applications Corporation. Report funded by EPA's funded by EPA's Office of Solid Waste and Emergency Response (OSWER).

Description: This report applied the Millennium Ecosystem Assessment ecological services framework to three Superfund sites where remediation was complete or underway. It provided three qualitative case studies "to describe how OSWER might work with state and local

stakeholders to actively *maximize the delivery of economic value from ecosystem services* at redeveloped Superfund sites."(p.18)

The sites were chosen because they were relatively rich in data and represented different ecological and social conditions. The report did not quantify or monetize values associated with different remediation options for the sites. Attachment A lists the three case studies and provides additional web-based sources of information about them.

Supplementary Information:

1. Memorandum OSWER 9355.7-06P, June 4, 2001from Larry Reed to Superfund National Policy Managers, *Reuse Assessments: A Tool to Implement The Superfund Land Use Directive*
   Reaffirms the Superfund Redevelopment Initiative to help communities return Superfund sites to productive use and introduced policies, procedures and practices, including public participation and identification of future land uses, to help implement the initiative

2. Website: "Local Economic Impacts of Site Redevelopment "
   www.epa.gov/superfund/programs/recycle/impacts/
   Results of a 2003 study to gather data on the reuse of properties cleaned up with assistance from or under the regulatory oversight of the Superfund Program. This study reviewed the local economic impacts of site reuse made possible by remediation. The study looked at 13 Superfund properties. The study's findings, reported in brief fact-sheets demonstrate the wide range of reuses that occur on these properties following cleanup as well as the value these reuses provide the local community. The study used only limited methods for valuation (e.g., value indicators are numbers of jobs gained, salaries gained over the period of the clean-up, increase in home prices over the clean-up period , increase in home or property values over the clean-up period and increased property taxes over clean-up period).

3. Region 5 Project: Accurately Capturing the Costs of Traditional versus Sustainable Redevelopment of Contaminated Properties (See Attachment B) describes an initial regional effort demonstrating need for valuation information and Region 5's interest in advice to strengthen valuation.

4. SAB Report, Advisory *on EPA's Superfund Benefits Analysis*, EPA-SAB-ADV-06-002
   http://www.epa.gov/sab/pdf/superfund_sab-adv-06-002.pdf
   (See Attachment C for excerpt)

5. SAB Report, Underground Storage Tanks (UST) Cleanup & Resource Conservation & Recovery Act (RCRA) Subtitle C Program Benefits, Costs, & Impacts (BCI) Assessments: An SAB Advisory, EPA-SAB-EC-ADV-03-001
   http://www.epa.gov/sab/pdf/ecadv03001.pdf
   (See Attachment D for excerpt)

4. Source Example Analysis

Source Example A
Charles George Landfill

A popular guide used by birders contains this expression of modernity:

> One late September day, several birders stood atop Mount Hoy some 30 miles southwest of Chicago and waited for the fog to lift from the surrounding hills. As the cloudy mist dissipated, a Cooper's Hawk flew out of a tree, followed by a Peregrine Falcon, and then another and another raptor speeding over their heads. Another time, birders counted 1,000 Broad-winged Hawks flying in thermals over Mount Hoy on a single day. In autumn, Chicago area birders who have hawks on their minds, also have Mount Hoy on their minds. Mount Hoy is not a mountainous anomaly in the midst of flat Chicagoland. It's actually a 150-foot-tall capped landfill, making it the best spot in DuPage County, if not the whole Chicago region to watch hawks.[i]

The Environmental Protection Agency (EPA) rightly presents the redevelopment of the Dupage County Landfill Site in Warrenville, Illinois, as an example of what can be done when ecological values inform the treatment and management of Superfund and other polluted sites. As EPA states, the development of this landfill provides a "testament to the positive impact that collaboration can have at a Superfund site. The hill, now known as Mt. Hoy, previously functioned as the Dupage County Landfill" which earlier had leached dangerous contaminants into area ground water.[ii] Listed as a Superfund site in 1990, "a once dangerous area is now a community treasure, where visitors picnic, hike, camp, and take boat rides on the lake."

By 1990, when the redevelopment of the Dupage County Landfill began, EPA had learned to plan projects with ecological values in mind – not exclusively concerns about human safety and health. Earlier efforts had less successful results when they focused exclusively on the control, mitigation, or elimination of health and safety hazards.

The Charles George Landfill near Lowell, Massachusetts (4 miles south of Nashua, New Hampshire) provides an example in many ways similar to that in Dupage County but where ecological values were not considered at the start. (An effort to make the site work environmentally has now begun.) The human health risks at this site were so salient at the time that they were discovered that they controlled subsequent decisions. When the landfill site was capped and the water system from Lowell was extended to the affected community, the health and safety concerns were addressed. The area remained something of a wasteland although it had the potential to be an environmental asset rather than nuisance.

At the Charles George site, EPA addressed risks to human safety and health initially and immediately, in part by extending municipal water services to those households relying on wells in the area, in part by collecting and treating leaching and run-off water, in part by flaring

off fumes, in part by placing an impermeable synthetic cover over the roughly 60-acre area (to prevent rain from penetrating and leaching), and in other ways. It did not (as happened in Dupage County) initially collaborate with local stakeholders and decision makers concerned with ecological and environmental quality, as well as other management objectives – not simply human safety and health. It was only after the major work had been done – including the placement of the impervious cap – that agencies began to address these other (mainly ecological) aspects of the site. The attempt at ecological restoration, lead by the U.S. Fish and Wildlife Service with EPA and various state agencies and local groups, is now beginning. The overall impression that emerges from the immense amount of information about the history of the landfill is that competent and effective management produced results that protected human health and safety but in a way that left major problems for the next stage of ecological reclamation. It might have been more efficient it the two tasks – or two sorts of issues – had been contemplated together, as they had been in Dupage County.

The failure to plan initially for ecological and environmental restoration (beyond the control of hazards to human safety and health) was understandable in this instance. If one studies the EPA 1992 Guidance on Sensitive Environments (http://www.epa.gov/superfund/sites/npl/hrsres/hrsgm/appa.pdf) one can argue that the Charles George site was not "sensitive" in the sense that it was not itself a wetland, breeding ground for waterfowl, endangered species habitat, or the like. Arguably, the Hazard Ranking System Guidance Manual of 1992 would not have required the management team to consider the area as ecologically sensitive – even had the team in 1983 had the advantage of the Manual, almost 10 years before it was issued, when EPA closed the landfill and started the clean-up.

A review of fact sheets and guidance issued by EPA for the implementation of CERCLA – for example, see http://www.epa.gov/superfund/sites/npl/hrsres/#Fact%20Sheets -- suggests that concerns about human safety and health are approached and treated separately from concerns about ecological goods or services. From a logical point of view, this makes sense: places where people live and congregate may be urban, developed, and the reverse of "natural" and yet safe from the perspective of health, while wild and natural places can be quite dangerous. Thus, EPA generally views ecological or "green" goals separately from its health-and-safety or "brown" goals – identifying "sensitive" environments (such as endangered species habitat) to anchor its efforts in the one direction and "sensitive populations," such as asthmatics, in the other.

The contrast with the results in Dupage County, however, suggests that ecological values in the Charles George and similar sites can be considered and entered into the management plan from the start even though this would not necessarily permit a single-minded pursuit of health-and-safety goals as important as they are. In fact, several research efforts and case studies (e.g., see McDaniels et al. 1999, Gregory 2000, Arvai et al. 2001, Gregory et al. 2001a, Gregory et al. 2001b, Gregory and Wellman 2001, Arvai and Gregory 2003) have explored decision making processes that are structured such that management choices simultaneously address multiple objectives. These approaches incorporate information from valuation studies, which forecast the expected benefits associated with each stated objective (i.e., human health and safety, environmental quality, opportunities for recreation, etc.) as they relate to each prospective management option. Thus, both the values associated with each objective and the composite values associated with management option can be considered by decision makers.

In terms of implementing such an approach, teams managing NPL and other contaminated sites ought to include members who could suggest ecological possibilities at the start. In the instance of the Charles George Landfill, for example, there might have been a discussion whether an impervious cap would present an obstacle for ecological restoration (the planting of trees, for example) and that various methods of phytoremediation along with vegetation likely to absorb and transpire rain might work to prevent a lot of leaching. This might be adequate since anyone within the possible plume would be provided drinking water from the Lowell municipal system.

It would be interesting to see if a stakeholder management group would permit some *de minimis* risk to human safety and health in return for increasing the ecological potential of the area. Unfortunately, the question did not – and possibly does not – arise because "green" and "brown" issues are treated separately – with "green" concerns initially relegated to the management of "sensitive" sites such as endangered species habitat. In the Charles George case, the FWS an other groups then came in nearly two decades later (in 2002) to make some ecological sense of site after it had been covered and otherwise contained simply to reduce, mitigate, and eliminate hazards.

There is no need here to go into the specifics of the Charles George site since these are fully and meticulously described in a series of reports which are available on agency websites. To read these reports is to come away with admiration for the effort undertaken at this site. It is also to wonder what might have been done if ecological values had been included in the original risk assessment and remediation plan.

For relevant information see, first, the FWS website describing its "Final Restoration Plan and Environmental Assessment (RP/EA), prepared by the Charles George Natural Resources Trustee Council (Trustee Council).
http://www.fws.gov/contaminants/restorationplans/CharlesGeorge/CharlesGeorgeSec1.htm

The history of the site is described in detail in this 2002 document.

EPA maintains a thorough website on the Charles George Reclamation Project. See:

http://yosemite.epa.gov/r1/npl_pad.nsf/f52fa5c31fa8f5c885256adc0050b631/ABD286D719D254878525690D00449682?OpenDocument

Of particular interest are the "Site Photos" which eloquently attest to the lack of any interest at the initial clean-up in the ecological aspects of the site.

Arvai, J. L., and R. Gregory. 2003. A decision focused approach for identifying cleanup priorities at contaminated sites. Environmental Science & Technology **37**:1469-1476.

Arvai, J. L., R. Gregory, and T. McDaniels. 2001. Testing a structured decision approach: Value-focused thinking for deliberative risk communication. Risk Analysis **21**:1065-1076.

Gregory, R. 2000. Using stakeholder values to make smarter environmental decisions. Environment **42**:34-44.

Gregory, R., J. L. Arvai, and T. McDaniels. 2001a. Value-focused thinking for environmental risk consultations. Research in Social Problems and Public Policy **9**:249-275.

Gregory, R., T. McDaniels, and D. Fields. 2001b. Decision aiding, not dispute resolution: Creating insights through structured environmental decisions. Journal of Policy Analysis and Management **20**:415-432.

Gregory, R., and K. Wellman. 2001. Bringing stakeholder values into environmental policy choices: A community-based estuary case study. Ecological Economics **39**:37-52.

McDaniels, T., R. Gregory, and D. Fields. 1999. Democratizing risk management: Successful public involvement in local water management decisions. Risk Analysis **19**:497-510.

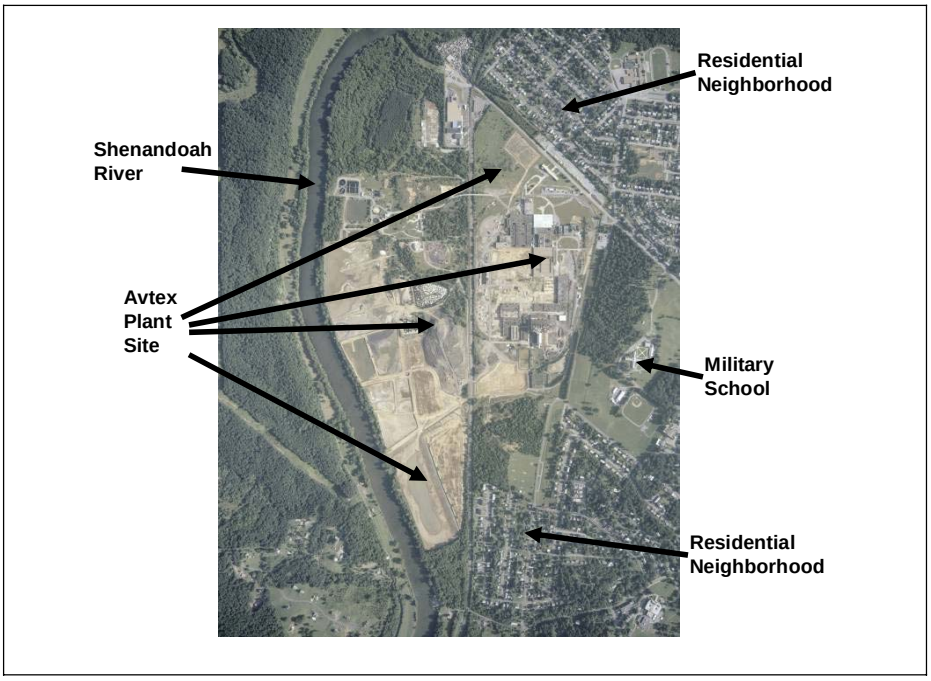
Source Example B
Avtex Fibers Superfund Site

Location

The Avtex Superfund site consists of 440 acres located on the bank of the Shenandoah River within the municipal boundaries of Front Royal, VA.

Historic Use

In the 1920s the site was primarily used for agriculture, with orchards along the river and field crops inland. From 1940 to 1989 industrial plants on the site manufactured rayon and other synthetics.



Social context

Front Royal is the tourist center for the Blue Ridge Mountains and is located in close proximity to the Appalachian Trail and Skyline Drive within the Shenandoah National Park and George Washington National Forest. The town has an established historic district and actively promotes its Civil War heritage. The Avtex site is within the municipal boundary and is bordered on the east by a military prep school (grades 5 -12); on the south by a residential neighborhood of moderate-income residents; on the west by the Shenandoah River; and on the north by a low to moderate-income residential neighborhood. 1,300 people live within a 3-mile radius of the site and depend on ground water as a drinking water supply.

Biological context

The site contains a few 5-year to 30-year-old forested stands comprised of upland deciduous and upland juniper forest as well as some remnants of floodplain forest. Additionally, there are open meadows and small wetland areas fed by storm water that provide habitat for a variety of wildlife. The more than a mile and a half of river frontage at the site provides an important link along the Shenandoah River corridor potentially providing safe wildlife migration routes and increasing functional habitat size by linking smaller pockets of habitat. The Shenandoah River

includes native bass and sun perch. In spring and summer, mallards, wood ducks, and herons can also be found on and near the site with spotted sandpipers and woodcock on the riverbanks and Baltimore orioles nesting in riverside sycamores. In winter, the presence of red-headed ducks and bald eagles has been documented. During migration, snow geese, swans, and eagles are seen throughout the river basin, with broad-winged hawks and monarch butterflies passing en masse in mid-September. Riverside wildflowers, such as cardinal flower with their attendant hummingbirds, are plentiful, as are swallowtails of all sorts along the river.

"Reconstruction" of ecosystem and ecosystem service value assessments relevant to the cleanup and restoration/reuse of the Avtex Fibers Superfund site.

Superfund Planning and Implementation Process (a "Reconstruction")

Possible applications of the C-VPESS e/s value assessment system are presented inside boxes after brief descriptions of each stage of the Superfund planning process as it appears to have been applied (or might have been applied in the Avtex fibers case.

Initiation

1. Site discovery and notification; Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)--The Avtex Fibers site was proposed to the National Priorities List of the most serious uncontrolled or abandoned hazardous waste sites requiring long term remedial action on October 15, 1984.

- It is not clear how e/s values were represented in the superfund nomination process.

Assessment

2. Preliminary Assessment/Site Inspection (PA/SI)--Tons of rayon manufacturing wastes and by-products, zinc hydroxide sludge, and fly ash and boiler room solids were disposed on site in 23 impoundments and fill areas encompassing 220 acres. Groundwater under the site and in residential wells across the river from the site is contaminated with carbon disulfide, phenol, sodium, and heavy metals including lead, arsenic, and cadmium. Polychlorinated biphenyl (PCB) from the site has been found in the Shenandoah River.

All components of the C-VPESS e/s value assessment system are required at this stage, but only at a very preliminary level of analysis.

- Ecological (toxicological, etc) experts review the biological context through available data and documents and site inspections and sketch a rough ecological model of how the identified pollutants and toxins might be transported and concentrated within and outside the site via air, land, surface-water and ground-water pathways;
- Social scientists and economist review the social context through available data and documents, including systematic content analyses of formal public comments, newspapers and government/agency documents (and perhaps some on-site interviews or simple surveys) to identify potentially important ecosystem services and values likely to be impacted by or placed at risk from the site;

Ecologists and social scientists interact to develop preliminary (back of envelope) ecological production functions that link expected bio-physical changes in ecological endpoints to relevant changes in e/s values potentially of concern to affected human populations. Cleanup actions that could potentially alleviate identified negative impacts and risks are identified and generally

characterized. Potential negative effects of actions on ecosystems and e/s values are considered as well as the potential for post-cleanup restoration/reengineering of the site for alternative uses and/or e/s values, consistent with the **Superfund Redevelopment Initiative (SRI),** for which the Avtex Fibers site is a pilot case.

- Results and conclusions are consolidated and communicated to relevant EPA and other involved agencies, as well as to concerned publics and other stakeholders;
- Appropriate agency managers, supported by ecological and social science experts, engage in initial dialogs with relevant industry, government, public and other stakeholder groups (in interview, public meeting or focus group formats) to confirm, extend and refine understanding of potential effects on relevant ecological systems and associated e/s values, and to further explore potential reuse/reengineering options after cleanup.

3. *Hazard Ranking System Scoring (HRS)*--The Avtex site is scored based on estimated risks to human heath and the environment.

4. National Priorities List process (NPL)—the HRS score is sufficient and the site is formally added to the list June 10, 1986, making it eligible for federal cleanup funds.

- It is not clear that the Hazard Rating System process currently gives sufficient consideration to e/s values. The HRS process determines whether a site qualifies for NPL, and so this is a critical screen. At a minimum HRS consideration of e/s values would require that the rough ecological-social e/s values models be developed and exercised to estimate the current and likely future levels of impacts, damages and risks from the site without listing and the implied cleanup actions.

5. Remedial Investigation/Feasibility Study (RI/FS)-- EPA began removal activities at the Site in 1989 to address various threats to human health and the environment when the facility was abandoned. Actions focused on operating the wastewater treatment system to protect the Shenandoah River from untreated discharges, removing or treating thousands of gallons of chemicals left in the deteriorating process lines, vessels and laboratories. EPA also removed the 22 carbon disulfide storage impoundments.

Documentation of the process and results of the development of alternatives for the Avtex Fibers site has not yet been found. It seems clear (as characterized above) that both EPA and State actions were initiated almost immediately after (indeed even before) the site made the NPL. We know that eventually a rather elaborate plan, with nature conservation-, recreation- and industrial-park components was developed and is currently being pursued. What other alternative cleanup/restoration options were considered, and how the current plan was selected remains to be determined. The following quote from an NAS report indicates what this stage of the Superfund planning process is supposed to be:

> The Superfund process requires that alternative approaches be developed to address risks to human health and the environment caused by sources of contamination and that the relative advantages of each alternative be compared and documented. (For OU-3 in the Coeur d'Alene River basin, alternatives were extensively investigated and described in the FS.)
> The process of identifying and developing potentially applicable cleanup methods is complex. This effort resulted in a massive, multivolume set of documents setting forth the details of each remedial alternative considered. Remedial alternatives focused on four separate but interrelated areas of risk (EPA 2002, p. 9-1).]

1

All components of the C-VPESS assessment system would again be required at this stage of the Superfund planning process, but now much more detailed and precise ecological and social-value models must be developed and applied to assess and compare specific cleanup and restoration alternatives.

- Ecologists (toxicologists, etc), economists and social scientists interact to develop integrated models that have sufficient precision to estimate and compare the e/s values associated with alternative cleanup and restoration plans. Collateral effects of cleanup activities and subsequent uses under each alternative plan must also be estimated.
    - Preliminary ecological models are extended and refined and detailed ecological production functions are developed for ecological endpoints associated with the most important economic-social values identified by the preliminary assessments and models. Additional field assessments and studies may be needed to support the ecological modeling, effects estimation and plan comparisons.
    - Economists and social scientists develop more detailed and precise assessments and models of the e/s values that are of most concern and apply those models to estimate the effects of alternative cleanup and restoration plans. Additional field value assessments and studies may be needed to support the e/s valuations and comparisons of alternative plans.
- Results and conclusions are consolidated and communicated to relevant EPA and other involved agencies, as well as to concerned publics and other stakeholders;
- Appropriate agency managers and involved ecological and social scientists engage in systematic deliberations among relevant industry, government, public and other stakeholder groups to assess and compare alternatives in a systematic tradeoff analysis and decision making context.

2

Example of an e/s value assessment

The chemical pollution, visual blight and other disturbances and the health and environmental risks associated with the Avtex Fibers industrial plant may have degraded e/s values for residents living near the site, as well as for tourists and recreators who pass by or visit in the area. All of the alternative cleanup actions under consideration would presumably achieve critical protection of human and ecological health in the vicinity of the site. Previous research using selling prices of housing (hedonic pricing studies) has shown that an important benefit of Superfund listing, cleanup and reduction of health and environmental risks is an increase (or recovery) in nearby residential property values. This is an important component of monetary benefit-cost analyses of individual projects, and of the Superfund program overall. Several of the (assumed) alternative plans for the Avtex site go beyond cleanup and risk management to include restoration and reuse of the site in ways that could promote further property value increases consistent with the frequently documented effects of "green belts." The restored natural ecosystems and enhanced recreational, aesthetic and other amenity values proposed for some of the restoration alternatives would very likely be appreciated by both residents and visitors in the area. While all of these plans are likely to yield greater e/s values than the current blighted and polluted conditions at the site, choosing among alternative cleanup/restoration plans requires more precise assessments of the values associated with each plan.

Systematic assessment and comparison of the e/s values projected for the alternative plans could be accomplished with an appropriate economic and/or social-psychological survey. Hedonic pricing studies can reveal the property values lost due to current (or historic) site conditions, but different methods are required to estimate values for alternative future conditions. Several different survey methods might be employed to this end. A typical ***conjoint survey*** in this context would present multidimensional descriptions of houses (including attributes such as size, construction material,

number of rooms, quality of schools, etc, perhaps similar to homes in or expected to be in the study area) along with descriptions of relevant conditions/features of the nearby Avtex site as projected for each of the plans under consideration. Survey participants are asked to choose between pairs of (hypothetical) homes/settings differing in several attributes at a time (variations of conjoint survey methods might present homes one at a time and require a rating or some other quantitative estimate of preferability). The exact composition of each of the hypothetical homes to be presented is determined by a sophisticated research design that balances and contrasts the different levels of each of the selected attributes.

The observed pattern of choices (expressed preferences) across the different pairs of (hypothetical) homes by a number of respondents can be analyzed to obtain quantitative estimates of the relative preferences among all houses presented in the survey (from most to least preferred) for the population of residents represented by the sampled respondents. Further analysis of choice patterns allows estimates of the relative contributions (regression coefficients) of changes in each of the home/setting attributes represented in the survey to changes in the overall preference scores. Important to the current applications, coefficients for the attributes that are directly associated with differences in the projected effects of the management alternatives for the nearby Avtex site provide quantitative estimates of the relative contribution of each plan to the preferences expressed for the homes presented in the survey. If home prices (e.g., total cost or monthly payments) are included among the attributes for the hypothetical home/setting combinations and a number of assumptions and conditions are met, the price attribute can be used to translate preference coefficients into dollar-valued estimates (w-t-p) of the contributions of the attributes associated with the alternative plans under consideration. This Contingent Valuation version of the conjoint survey may be seen as a prospective, expressed preference version of the hedonic pricing, revealed preference assessment method, and the monetary values provided may be important for some assessment needs.

For many familiar attributes of homes (number of bathrooms, size in square feet, etc) brief verbal/quantitative descriptions may be adequate representations for the purposes of an e/s value survey. Verbal descriptions might also provide respondents with adequate and valid representations of some important attributes of the Avtex site before and after cleanup and restoration. Indeed, attributes such as concentrations of toxic chemicals and their relative safety/risk to human health or to ecosystems might only be communicated in this way. However, when important attributes of plan alternatives are more subtle or are very difficult to describe well in words, other representations may be required. The visual characteristics of the Avtex site after restoration will be important to nearby residents, to recreators and visitors to the site and to tourists passing by. In many cases verbal descriptions can not adequately describe the relevant variations in conditions, nor will descriptions provide a sufficient basis for survey respondents to distinguish between the projected outcomes of one cleanup/restoration plan versus another. In these cases visual/graphic displays can be very effectively used to represent these attributes in a survey. As with verbal descriptions, visual representations must be true to the projected bio-physical conditions that are projected for each alternative. Research has also shown that rather high levels of visual realism are required if respondents choices in a survey are to provide valid estimates of responses to actual environments with the features depicted.

Decision

6. Records of Decision (ROD)—Whatever the process employed, a final cleanup/restoration plan was selected (or evolved into?). The plan calls for most remaining wastes to be consolidates on site and secured with a protective material (where needed), and a thick soil cover and vegetation (cap). The areas are to be monitored to ensure the cap remains protective and ground water remains unaffected in the future.

7. Remedial Design/Remedial Action (RD/RA)--Through a formal Multi Stakeholder Group, participants developed a redevelopment plan that divides the site into three areas: 1) a 240-acre River Conservancy Park along the Shenandoah River combining ecological restoration and conservation of native habitats; 2) a 25-acre Active Recreation Park with boat landings, picnic shelters, and recreational facilities including soccer fields; and 3) a 165-acre Eco-Business Park, featuring the refurbished historic former Avtex administration building, which will establish high green/environmental standards for all industrial facilities.

Documentation of how the Multi Stakeholder Group was formed and functioned and the role it may have played in the formulation/selection of the final plan for the site has not been found. One document described an EPA announcement inviting public comment on the "Proposed Plan."

> **On May 29, 1999, EPA opened a public comment period. Interested parties may comment on the Proposed Plan until July 2, 1999.**
>
> EPA will hold a public meeting to present the Proposed Plan and to address questions and concerns. The public meeting will be held at **7:00 p.m. on June 17,1999, at the Town Hall Council Chambers, 16 N. Royal Ave. in Front Royal.** (Call (540) 635-807 for more detailed directions.)
>
> EPA will summarize and address all comments received at the public meeting and written comments postmarked by July 2, 1999, in an Action Memorandum. The Action Memorandum will document EPA's final selection of the closure plan for the three management units, and will be available to the public in the Administrative Record file at the information repository.

The roles for the C-VPESS e/s value assessment system in this stage of the project could include monitoring to determine whether projected ecological and social outcomes are being achieved and assessments and modeling to support the continuing design process. For example, after the overall plan for the site has been selected there will be numerous decisions about specific details for the components of the project that might be assisted by projections of ecological effects and social values.

Cleanup

8. Cleanup activities—EPA began removal activities at the Avtex Site in 1989 to address various threats to human health and the environment when the facility was abandoned. From 1989-1998, EPA conducted a series of emergency and on-going removal response activities to address threats to human health and the environment as the facilities at the site continued to degrade after closure. By September 1998, EPA had completed the demolition and consolidated demolished rubble and waste materials into waste piles. Most of these materials were either cleaned for reuse on-site or transported off-site for recycling or disposal. In late May 2004, treatment of the remaining debris from EPA's 17-acre building demolition began. EPA signed an Action Memorandum on December 21, 2001 to decontaminate the remaining buildings and excavate the remaining sewers. FMC began decontaminating the remaining buildings in January 2002 and is expecting to be complete this work in September 2005.

C-VPESS system assessments might be used to monitor whether construction was successful in achieving projected ecological changes and protections and associated e/s values. In addition to assessing outcomes, there may some need for assessments of alternative means of achieving those outcomes.

Close out

9. Construction Completion—Numerous documents, maps and photographs indicate that construction and modifications to achieve the cleanup and restoration plan that was apparently selected is well along. Other documents contradict this impression, so the exact state of the Avetx Fibers project is a bit ambiguous at this moment.

One document recounting progress on the Avtex cleanup and restoration includes the following statement:

EPA anticipates that the preferred cleanup option will be proposed in the Winter of 2006.

This seems inconsistent with other documents showing photographs of completed sections of the restoration, including water retention ponds and a number of soccer fields, and with declarations about progress on the industrial park presented on the Front Royal web page, including a recent bulletin that some entity is about to purchase the industrial park (or development rights thereto).

Post-construction

10. Post Construction Completion—This stage of the Superfund process includes Long-Term Response Actions (LTRA), Operation and Maintenance, Institutional Controls, Five-Year Reviews, Remedy Optimization and NPL Deletion.

C-VPESS system assessment might be useful in the determination that ecological protection goals have been accomplished so that the site can be de-listed.

One Cleanup Program

EPA is implementing the One Cleanup Program to coordinate cleanup and revitalization of sites across programs (Superfund, Brownfields, Underground Storage Tanks, etc) to make better use of resources, improve communication with the public about such programs, and to better integrate future landuse decisions with cleanup decisions.

An implication of the One Cleanup Program for the C-VPESS e/s value assessment system would be that methods and models for any given site/project should be developed with the intention that they, and possibly their results, could readily transfer to other cleanup and restoration projects in the future. With hundreds (perhaps thousands) of cleanup/restoration projects already scheduled and tens-of-thousands more at various levels of nomination and consideration, it will be critical that e/s assessment and modeling methods be developed and streamlined for more effective and efficient use in future projects. This should be a major consideration as methods are designed for individual projects. To that end it would be very useful if there were a readily accessible and well organized inventory of the types of cleanup/restoration projects that are planned or are likely in the relatively near future. Projected sites might be categorized by ecological systems, by likely pollutants/toxins, and by biological-ecological and human/social systems contexts likely to be involved.

Superfund Listing, Planning and Action Process	
Initiation	1. Site discovery and notification; Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)
Assessment	2. Preliminary Assessment/Site Inspection (PA/SI) 3. Hazard Ranking System Scoring (HRS) 4. National Priorities List process (NPL) 5. Remedial Investigation/Feasibility Study (RI/FS)
Decision	6. Records of Decision (ROD) 7. Remedial Design/Remedial Action (RD/RA)
Cleanup	8. Cleanup activities
Closeout	9. Construction Completion
Post Construction	10. Post Construction Completion Long-Term Response Actions (LTRA) Operation and Maintenance Institutional Controls Five-Year Reviews Remedy Optimization NPL Deletion
Restoration/ Reuse/ Reengineering	Superfund Redevelopment Initiative (SRI)
One Cleanup Program	Coordinate cleanup and revitalization of sites across programs Manage all waste programs for coordination of resources, activities, results Better communication to (<u>with</u> would be better still) the public Integrate future land use decisions into cleanup decisions One Cleanup Program

Source Example C
Leviathan Mine, CA

Key facts:

- Inactive sulfur mine (open pit mine since 1951; closed since 1962)
- 24 miles southeast of Lake Tahoe
- Physical disturbance covers 253 acres on site
- National forest surrounds site
- Disturbance also covers 21 acres of national forest land
- No permanent residents within several miles
- 22 million tons of waste rock and overburden were removed and placed along channels of creeks that drain into the East Fork Carson River
- Waste rocks and fractures have high sulfur content.
- Precipitation and snowmelt resulted in highly acidic acid mine drainage (AMD) discharged directly into creek.
- AMD leached heavy metals (arsenic, copper, nickel, zinc, chromium, aluminum, iron)
- AMD flows into downstream creeks, which empty into East Fork of Carson River (10 miles downstream)
- AMD had low pH and high metals content , which have negatively affected
    - Aquatic and wildlife habitat in downstream creeks
    - Riparian vegetation throughout watershed

Policy frame/Valuation context or question:

It seems there are several alternative policy frames one could take here. These include:

- "Determining and quantifying natural resource injuries and calculating the damages associated with those injuries." In this case, the baseline would be the ecological conditions before/without mining. We would want to measure and value the impact on the ecosystem itself and the losses in ecological services resulting from the mining activities.

- The decision about whether to list the site on the NPL. Of course, listing per se has no effect on the ecosystem at the site, so in this context the valuation question would have to be couched in terms of the value of the cleanup that is expected to occur if the site is listed. (In fact, the EPA website states that a number of voluntary measures proved inadequate and led to the ultimate listing of the site.) This would have to make some assumptions about possible remedial actions, and then proceed in much the same way as you would for the following frame.

- Evaluating the benefits of alternative remedial action or management plans (after listing).
    - One of these was the LRWQCB (Lahontan Regional Water Quality Control Board) Leviathan Mine Pollution Abatement Project (conducted between 1983

and 1985). Here the baseline would be the improvement in the ecosystem and the flow of services that resulted from the Project.

- An evaluation of the second LRWQCB major work plan in 1999. In this case, we would need to predict the ecological changes (and associated values) resulting from these additional remedial actions (given a baseline of what was done in the first phase between 1983 and 1985).

- The purchase by ARCO of a 480-acre conservation offset area in a location surrounded by national forest. This was part of a settlement with ARCO. Here the question might be: what are the ecological benefits that would result from setting this site aside as a conservation area? This could be compared to the value of the ecological services lost as a result of the mining to see if the "offset" is sufficient. In this case, the baseline is the ecological services one would get from the site if it were not set aside as a conservation area.

The specific nature of the valuation exercise (e.g., the baseline and changes that are considered) will depend on the policy frame.

Ecosystem Features that are Impacted

- Degradation of water quality of creeks and river -- hazardous substances released into creeks, which feed into East Fork of the Carson River, both through surface water runoff and leaching into groundwater discharged into creeks

- Degradation of groundwater quality

- Reduction in groundwater recharge (?)

- Degradation of soils in stream banks and floodplains

Ecosystem Services that are Impacted

1. Habitat used by aquatic resources such as insects and fish (e.g., cutthroat trout) (through impacts on surface water, streambed, bank sediments, and riparian vegetation) **(Note from KS: for habitat, I'm not sure if it should be included as a separate service or if it is an input into another service – see Jim Boyd's distinction. Why do we care about protecting habitat? Because we care about the populations it supports for their own sake, or because these populations are an input into something else we value, such as recreation? If we care about the insects for their own sake, then maybe this should be included in (5) below. If we care about them because they are a food source for fish and we care about fish, then we should value the change in fish brought about by the change in insects but not value both separately, i.e., we should view both clean water and insects as inputs into the production of more fish, and value either the inputs or the output. Of course, then there is the question of why we value the fish. If we value their "existence" (for**

whatever reason), then maybe this should be part of (5) below. On the other hand, if we value them because of recreational fishing, then maybe this should be part of (11) below. Perhaps part of this whole exercise is to first try to answer the question of why we value the insects or fish. It seems we need to know this before we can figure out how to measure how much we value them.)

2. Habitat used by wildlife such as birds (e.g., bald eagle) (through impacts on water, streambed, bank sediments, and riparian vegetation, as well as effect of impacts on aquatic food sources) **(comment similar to above applies here as well)**

3. Water used by Washoe Tribe members and others on Washoe reservation for washing and drinking (campground?)

4. Water used by people (?) in other Public Indian Trust Allotments (some of the Pine Nut Allotments) for washing and drinking

5. "Existence" values (broadly defined, based on moral or other principles) from threatened species (e.g., cutthroat trout, bald eagles, and others)

6. Non-consumptive use values of wildlife (e.g., people like to view bald eagles and other species)

7. Harvesting (hunting, nuts, fish) by Washoe tribal members

8. Cultural/spiritual and ceremonial value of land used by Washoe tribal members

9. Water flow regulation (e.g., reduction in flooding from snowmelt or runoff)

10. Hiking/camping??? **(Note: This is listed in Table 4, but there is no information provided about whether or how much hiking or camping there is in the immediate area of the site or how it has been affected)**

11. Recreational fishing in the watershed??? **(Again, this is listed in Table 4 but not explained)**

Identification of Ecosystem Impacts that Matter Most

Now that we have a list of possible impacts, we need to determine which ones are potentially important and hence should be the focus of the valuation exercise. This depends on both the magnitude of the ecological impact and its importance to society. Both of these need to be judged.

Preliminary assessment of the magnitude of the various ecological impacts

This requires some initial site assessment. The EPA website states that "critical environmental data have been gathered to help characterize the site, including streamflow, water quality, sediment chemistry, meteorological data, and stream biological measurements." In addition, it states that "ARCO must compile all existing data as well as collect new information on the mine and

the watershed to understand the effectiveness of the early actions. ARCO will also collect much of the new information necessary for a clear understanding of site conditions and downstream effects."

It seems that there are two major parts to this initial site assessment. One is measuring what is coming off the site, both in terms of quantity and composition. The other is measuring its impact on the surrounding ecosystem. It seems that this can be determined to some extent by sampling the water quality, sediments, etc. at various distances from the site to determine how much they are impacted by runoff/leaching from the site. Presumably, EPA and/or the PRPs (ARCO) are doing this and have good data at this level.

More importantly, impacts on water quality, sediments, etc., need to be translated into predicted changes in the flows of the services listed above. This is more difficult. In principle, it requires the estimation of an ecological production function. For example, to see if recreational fishing is likely to be significantly impacted, we would need to estimate the impact of the site on the fish population in the nearby river. This requires estimation of the impacts of the changes in things like water quality, streambed, bank sediments and riparian vegetation, on fish population, both directly and indirectly through their impact on the insect population. Does a model for doing this at the Leviathan mine exist? Most likely not. At this stage, EPA might instead look at the scientific literature to see what it says about how sensitive the insects and fish species of concern here are to these types of stressors and then ask expert ecologists to provide some expert judgment on the likely magnitude of the impacts in this specific case. (This would be akin to an "ecological impact transfer", similar to the notion of benefits transfer.)

Preliminary assessment of what types of ecological changes matter most to people

This requires going through the list to gather some "indicators" that would provide information about what people care or are concerned about.

It seems that this could have three useful components. The first would be to gather information about the relative importance of the various services listed above in this particular context through focus groups, mental models, mediated modeling, deliberative processes, etc. **(Note from KS: I'm not sure on the formal definitions of all of these methods or the distinctions among them, but the idea would be to talk to people directly to see what they seem to be most concerned about and which services they view as most important. This could be done formally or informally. I assume Terry, Joe, etc., can provide more detail here. These methods could also presumably help to answer some of the questions raised in my note regarding why we value habitat improvements.)**

The second component would be to gather some basic information that could be used to judge the importance of different services. This might be of the type used to construct environmental benefit indicators. Examples would be: Water use data for the Washoe tribe and others in the vicinity of the site (e.g., sources, quantities, purposes); harvesting information for the Washoe (e.g., what percent of their harvesting of nuts, fish, etc. comes from the area impacted by the site); recreational use data (how many people visit the area of the national forest impacted by the site for hiking, camping, fishing, wildlife viewing); data on flooding potential and what is at risk in the vicinity of the site; data on spiritual/cultural land use practices by the Washoe. Is this information available for the Leviathan mine site? Not clear.

The third component would be a review of related literature and previous studies to draw from what has been learned in other contexts. For example, previous (social psychological?) surveys (not specific to this site) or other expressions of environmental preferences/views (e.g.,

outcomes of referenda, civil court jury awards, citizen juries, etc.) might suggest provide insight into what people are likely to care about in this context. Similarly, previous economic studies of existence value might provide some (at least partial) indication of the likely importance of impacts on species such as bald eagles (e.g., if they show that existence value is large).

All of this information could be used to screen the initial list of impacts on ecological systems and services to identify which warrant further, more detailed analysis.

etc., etc……

The Discussion section is at a very preliminary stage of development. The subcommittee plans to provide a discussion regarding the significant scientific and policy challenges faced by the superfund program in quantifying the benefits to humans and the environment from superfund site remediation and redevelopment. As well specific cross-cutting issues from the individual case studies will be discussed. What follows is very raw and has not been discussed thoroughly by the subcommittee but should give some sense of what we hope to achieve

4. Discussion

4a. Scientific and Policy Challenges

The linkage between risk assessment endpoints and ecosystem services is poorly described for many effects and associated assessment endpoints typically used in remediation. The Agency has recognized the need to link ERA endpoints with ecological services (Ecological Benefits Assessment Strategic Plan, November 3, 2004).

Connecting ecological value with actions that mitigate risks to individual organisms provides two major challenges. First there is the difficulty of linking any individual organism with an ecological service. Ecological services are primarily associated with a population of organisms or a community of populations acting in concert. The loss of an individual from a population of organisms is not likely to cause the ecological service(s) derived from that species to be measurably diminished. A notable exception to this is the loss of an individual from a population of a species that is at risk of local or more pervasive extinction. The second challenge is that of connecting risk with injury. Since toxicological risk is the probability of a adverse response by an organism to a chemical exposure and injury is the actually negative response associated with loss of life or physiological function there is this leap of scientific faith that by mitigating risk the corresponding injuries are prevented.

The way this plays out in many contaminated property assessments is that the data set collected, as part of the site characterization, focuses primarily on the identification chemical species, and their concentration in various physical media. In the first pass analysis, these concentration data are then compared with effects information from the literature to assess if the site presents unreasonable risks requiring mitigation. If a risk rises to the level of concern then more sophisticated approaches using exposure and effects models will be applied to refine the risk analysis.

Important data related to environmental condition such as the structure and function of ecological components are seldom collected in the site characterization and therefore what data is collected is inadequate detail to assess injury. The information is more likely to focus on qualitative estimates of habitat types and lists of species present or could be present. Developing a better understanding of what data is needed to assess both the risks to be mitigated and the benefits derived from alternative remedial approaches will lead to more productive outcomes.

4b. Cross-cuttings Issues from Source Examples

A number of important issues were raise during the Leviathan Mine source example analysis. These included:

(1) The **importance of bringing community values** for ecosystems and their services into the process early on when designing possible remedial actions/responses;

(2) **How best to define ecosystem services**, using habitat as a key example. While the Millennium Assessment typology is helpful in defining services comprehensively, it may be less helpful in defining services for valuation purposes; may be more useful to adopt the Boyd approach. Highlights (1) as well, because how the 'service' associated with improved habitat is defined depends on what it is that people value.

(3**) The need to move from estimating/measuring impacts defined** in terms of stressor to estimating/measuring impacts defined in terms of ecosystem services. For the NRDA process, detailed data were collected on elevated levels of heavy metals in water, fish tissues, insects, etc.; need to translate these into impacts on services. This is particularly challenging in this context, where ecological effects can occur far off-site (because the creeks that are immediately impacted flow into the river).

(4) **The importance of the policy frame, i**.e., need to define explicitly the policy context and the nature of the valuation question that is useful/relevant in that context. Can determine the role of estimating the benefits of ecosystem services versus using a HEA-type approach.

(5) **The treatment of cultural/spiritual and other related values**, which in the context of the Leviathon Mine source example include values held by the local tribal populations.

(6) **The importance of existence or related values**, given that the Leviathon Mine site is remote and human use of the area (other than by the local tribal community -- see above) is limited.

Attachment A

Case Studies Described in Matthew Wilson, M. A. (2004). *Ecosystem Services at Superfund Redevelopment Sites, Revealing the Value of Revitalized Landscapes through the Integration of Ecology and Economics*.

	Type of Site/Timeline and Status of EPA decision-making	**Other Redevelopment Activities**	**Other Sources**
Charles-George Reclamation Trust Landfill Tyngsborough, MA	Urban Site proposed:10/23/1981 Construction complete status attained 9/1998		US Fish and Wildlife Service, Final Restoration Plan And Environmental Assessment (includes ecological assessment of remediation options): http://www.fws.gov/contaminants/restorationplans/CharlesGeorge/CharlesGeorgeTOC.htm EPA Site History: http://yosemite.epa.gov/r1/npl_pad.nsf/f52fa5c31fa8f5c885256adc0050b631/ABD286D719D254878525690D00449682?OpenDocument
Leviathan Mine Alpine County, CA	Rural, mining site Site proposed: 1999 Listed on NPL: 2000 Final Assessment Plan: 2003 Proposal for Year-Round Treatment System: 4/2004		EPA NPL Site Narrative for Leviathan Mine: http://www.epa.gov/superfund/sites/npl/nar1580.htm Leviathan Mine National Resource Damage Assessment Plan, prepared by the Leviathan Mine National Resource Damage Trustees (Washoe Tribe of Nevada and California U.S. Bureau of Indian Affairs U.S. Fish and Wildlife Service U.S. Forest Service California Department of Fish and Game and Nevada Division of Environmental Protection with Stratus Consulting) http://www.fws.gov/sacramento/ec/Leviathan%20NRDA%20Plan%20Final.pdf

	Type of Site/Timeline and Status of EPA decision-making	**Other Redevelopment Activities**	**Other Sources**
Avtex Fibers Site Front Royal, VA	Suburban site with recreation values Site proposed: 10/15/1984 Listed on NPL: 06/10/1986 EPA anticipates that the preferred cleanup option will be proposed in the Winter of 2006.	EPA website describing site as one of ten original pilot sites selected to participate in EPA's Superfund Redevelopment Initiative (SRI). http://www.epa.gov/superfund/accomp/success/avtex.htm Stakeholders have developed a formal "Avtex Fibers Conservancy Park Master Plan" http://www.avtexfibers.com/Redevelopment/avtexWEB/avtex-Mp.html\ Aftex Fibers Redevelopment Map: http://www.avtexfibers.com/HomeMain.htm	

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Attachment B

Region 5 Project: Accurately Capturing the Costs of Traditional versus Sustainable Redevelopment of Contaminated Properties

Valuation Issue: Many of the costs associated with traditional methods of redevelopment (high percentages of impervious surfaces, low density development, destruction of prime farmland and greenfields, increased vehicle miles traveled, increased maintenance, energy and infrastructure costs) are external to the developer's costs and are born to society and downstream/wind ecosystems. Conversely, the economic, social, ecological and environmental benefits of sustainable, low-impact style developments are well not known or well accounted for in the current market structure.

EPA Decision/Reason for Valuation: EPA Region 5 is interested in studying the market barriers to sustainable redevelopment. This project will begin in 2006, and it is expected to continue through 2007. Region 5 currently believes that part of the solution will involve moving the market to more accurately reflect the costs of traditional development styles and the savings generated by sustainable designs. In order to transform the market, it will be imperative to accurately measure the externalities of traditional development and properly value the many public benefits derived from sustainable infill style development. In this effort, Region 5 is working with many partners across the region, and plans to hold conferences regarding this issue in Minneapolis, Chicago and Detroit.

Background:

A lack of quantified information on the performance and benefits of "green" design features is an obstacle to implementing green retrofit best management practices. There is a need to provide engineers, developers, planners and project decision-makers with accurate, reliable and quantified information on the performance, cost effectiveness, and environmental benefits of these features if we hope to see them widely implemented. Quantified green retrofit data will also allow state and federal environmental agencies to better measure and document the environmental and human health improvements attributable to sustainable design practices. There are many examples of factors that discourage sustainable redevelopment projects, including access to capital, the secondary mortage market, and a lack of best management practices (BMP) performance data. Examples of market-related factors that may discourage sustainable redevelopment projects include:

- In project budget analyses that focus on first costs there may be insufficient consideration of long-term cost savings (such as reduced energy/operating costs).
- In project budget analyses there may be insufficient consideration of public costs or benefits, including downstream costs (e.g., impacts on downstream communities from upstream development activity).
- A lack of cost effectiveness data between best management practices and traditional approaches to storm water management makes developers hesitant to

implement these practices.

Goal

The goal of this project is to partner with subject matter experts, users of the data and universities to identify key green retrofit quantification needs in the areas of air quality, water quality / storm water management, ecological function and economics, in order to develop and implement specific research proposals that support the use of these green design practices. Region 5 would very much like to have the thoughts of the SAB on these issues. Particularly, it is interested in learning what other parallel projects may be underway, and which researchers are working on these issues.

Decision-maker: EPA Headquarters and Region 5, Minnesota Environmental Initiative, Cleveland State University's Center for Environmental Finance, University of Michigan, University of Illinois - Urbana Champagne, Several Chicago Financial Institutions - TBD. Audience for the work is seen as EPA - both the headquarters Brownfields office and Region 5 managers concerned with documenting performance of EPA programs and what Region 5 calls "customers of the data". For the economics project, this would include developers, researchers, planners and local decision makers (city council, mayors, etc).

Current Status of Valuation Work: This project is just at the beginning phases. Staff from Region 5 are working with a team of outside experts on an economic research team[6] to identify projects and interested customer. Once two or three projects have been identified, the team is planning on seeking funding from OSWER and foundations. Academic partners may have granting opportunities. A potential project, for example, might involving valuing the environmental benefits of green development, and then running some simulations where we include those values into a developer's standard approach and see how the inclusion of those values change impact development choices.

[6] Economics Research Team: John Braden, University of Illinois at Urbana Champaign; Chris DeSousa, University of Wisconsin – Milwaukee; Ken Chilton, University of North Carolina – Charlotte; James Van der Kloot, Region 5; Bob Newport, Region 5; Karen Bandhauer, Region 5. The region has communicated with staff of ORD's National Risk Management Research Laboratory in Cincinnati, but otherwise has worked independently of other regions and EPA's National Center for Environmental Economics

Appendix A: C-VPESS Subcommittee on Valuation for National Rulemaking: Aquaculture Rule Source Example:

List of Subcommittee Members:

Dr. William Louis Ascher, Donald C. McKenna Professor of Government and Economics, Claremont McKenna College, Claremont, CA

Dr. A. Myrick Freeman, Co-Lead, Research Professor of Economics, Department of Economics, Bowdoin College, Brunswick, ME

Dr. Robert Huggett, Consultant and Professor Emeritus, College of William and Mary, Williamsburg, VA

Dr. Douglas E. MacLean, Professor, Department of Philosophy, University of North Carolina, Chapel Hill, NC

Dr. Harold Mooney, **Co-Lead**, Paul S. Achilles Professor of Environmental Biology, Department of Biological Sciences, Stanford University, Stanford, CA

Dr. Stewart Paul Slovic, Professor, Department of Psychology, Decision Research, Eugene, OR

Dr. V. Kerry Smith, University Distinguished Professor, Department of Agricultural and Resource Economics, College of Agriculture and Life Sciences, North Carolina State University, Raleigh, NC

Dr. Robert Stavins, Albert Pratt Professor of Business and Government, Environment and Natural Resources Program, John F. Kennedy School of Government, Harvard University, Cambridge, MA

Overview of Aquaculture Rule for C-VPESS Subcommittee on Valuation for National Rulemaking

Valuation Issue: What are the benefits associated with the new regulations in the final rule? What were the benefits associated with options described in the proposed rule?

EPA Decision/Reason for Valuation:

On June 30 2004, EPA finalized a new rule establishing effluent limitations guidelines (ELGs) for concentrated aquatic animal production (CAAP), or aquaculture, facilities. The regulation applied to CAAP facilities that generate wastewater from their operations and discharge that wastewater directly into waters of the United States.

The scope of the rule is described in Attachment 1. Attachment 2 provides a table of technologies required by the final rule compared with other options considered by EPA

Authority for and Genesis of Rule

Title III of the Clean Water Act (CWA) gives EPA authority to issue effluent guidelines, national standards for wastewater discharges to surface waters and publicly owned treatment works (municipal sewage treatment plants). The standards are technology-based (i.e. they are based on the performance of treatment and control technologies). They are not based on risk or impacts upon receiving waters.

When EPA completed this regulation, it completed all the regulations required by a January 1992 settlement with the Natural Resources Defense Council and others, which established a schedule by which EPA would consider regulations for 19 industrial categories. Section 304(m) of the Clean Water Act governs how EPA works with the public in identifying identify industries for which effluent guidelines need to be revised or developed.

Requirements for and Use of Cost-benefit Analysis

The CWA includes no mandate for cost-benefit analysis. As a technology-based rule, decision-making centers on analysis of cost-effectiveness. The CWA, however, does not prevent EPA decision-makers from considering cost-benefit analysis as part of the entire technical analysis supporting a decision.

Under Executive Order 12866 the Agency must determine whether a regulatory action falls under the definition of a “significant regulatory action” which requires a cost-benefit analysis and OMB review. EPA generally conducts a cost-benefit analysis for rules that might meet this trigger.

Information in cost-benefit analysis is used by decision makers, especially for controversial issues. Analysts supplement formal monetized cost-benefit analysis with

narrative description of non monetized benefits to explain benefits of different regulatory options. These narrative descriptions are often removed stripped from final assessments because of the time involved in developing them and negotiating final language with OMB.

Decision-maker who was to use analysis: Acting Administrator,

Other audiences for valuation information:

Other audiences include: OMB and interested and affected parties (e.g., regulated entities, trade associations, environmental groups, and the technical experts hired by these parties. In the case of some effluent guidelines (not the aquaculture guidelines) regulated parties may be interested in the valuation because they may have the ability to apply for waivers from site-specific permits because particular circumstances do not justify the cost-benefit standard established in the final economic assessment.

Status of Valuation Work and Chronology of Valuation Effort:

Final rule published	June 30, 2004	http://www.epa.gov/fedrgstr/EPA-WATER/2004/August/Day-23/w15530.htm
Final benefit analysis[7] published	June 2004.	http://www.epa.gov/waterscience/guide/aquaculture/EEBA/index.html
Due date for comments on proposed rule:	January 27, 2003.	
Proposed rule published	September 12, 2002	http://www.epa.gov/fedrgstr/EPA-WATER/2002/September/Day-12/w21673.htm
Proposed benefit analysis[8] published	September 2002.	http://www.epa.gov/waterscience/guide/aquaculture/ea/ea.htm

The web page for the rule (http://www.epa.gov/waterscience/guide/aquaculture/) contains a more complete chronology and links to relevant documents:

[7] Economic and Environmental Benefits Analysis of the Final Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Industry Point Source Category (hereafter called "final assessment"), EPA-821-R-04-013

[8] Economic and Environmental Impact Analysis of the Proposed Effluent Limitations Guidelines and Standards for the Concentrated Aquatic Animal Production Industry (hereafter called "proposed assessment") EPA-821-R-02-015

"Bottom-line" Costs and Benefits

In the final assessment, EPA described the costs and benefits of the final rule option in the following ways. The Agency provided "Estimated Pre-Tax Annualized Compliance Costs and Monetized Benefits" (2003 dollars) (see Table ES-4 in the final assessment)

Estimated Total Costs	$1,445,000
Estimated total Benefits	$66,000 to $99,000

> "Monetized benefit categories are primarily in the areas of improved surface water quality (measured in terms of enhanced recreational value). EPA also identified a number of benefits categories that could not be monetized, including reductions in feed contaminants and spilled drugs and chemicals released to the environment, as well as better reporting of drug usage to permitting authorities." (p. ES-12)

In the proposed assessment (see p. 10-1), EPA described the benefits in the following way:

> "EPA has quantified and monetized a subset of the anticipated benefits of the proposed action listed above. The central basis for the quantitative benefits analysis is a water quality modeling assessment that estimates water quality responses to the pollutant loading reductions under technology options described earlier in this document. Specifically, the benefits that EPA has been able to quantify are (a) water quality improvements in stream reaches downstream of flow-through and recirculating systems, and (b) improvements in the recreational use value of these same reaches. Benefits that were not quantified include water quality and ecological responses to pollutant loading reductions at net pen systems and ecological and other water resource benefits from reductions in releases of non-native species, aquatic animal pathogens, and drugs and chemicals used at CAAP facilities. EPA did not quantify or monetize these potential benefits due to lack of readily available assessment modeling tools for such an analysis. Thus, the estimated monetized benefits of the proposed action are based only on a portion of the expected environmental benefits of the proposed regulation."

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Overview of EPA Valuation: Key Sections of EPA Documents

Identification of potentially important ecological changes	**Final benefit assessment: Chapter 7 on Environmental Impacts from Aquaculture Facilities.**	**http://www.epa.gov/waterscience/guide/aquaculture/EEBA/EEBA%20-%20Chapter%207.pdf**
	Proposed benefit assessment: Chapter 9 on Environmental Impacts of the AAP Industry in the U.S	http://www.epa.gov/waterscience/guide/aquaculture/ea/ch9.pdf
Characterization and /or quantification of benefits (non-monetary terms and monetary terms)	**Final benefit assessment: Chapter 8 on Environmental Benefits of Final Regulation,**	**http://www.epa.gov/waterscience/guide/aquaculture/EEBA/EEBA%20-%20Chapter%208.pdf**
	Proposed benefit assessment: Chapter 10 on Environmental Benefits of Proposed Regulation and Chapter 11., Section 1, Cost-Benefit Comparison	http://www.epa.gov/waterscience/guide/aquaculture/ea/ch10.pdf http://www.epa.gov/waterscience/guide/aquaculture/ea/ch11.pdf
Characterization of uncertainty and data quality	**Final benefit assessment: Chapter on Environmental Benefits of Final Regulation, Chapter 8, especially section 8.2.7, Source of Uncertainty**	**http://www.epa.gov/waterscience/guide/aquaculture/EEBA/EEBA%20-%20Chapter%208.pdf**

Other Aspects of the Analytical Process

Data constraints:

The CWA provides direct authority for EPA to survey industries concerning technologies and costs related to effluent guidelines. OMB review of such surveys under the Paperwork Reduction Act does not impede development of regulations. There is no authority provided for data collection related to the benefit of such regulations.

Resource constraints:

The Office of Science and Technology prepared the final assessment with the support of Eastern Research Group, Incorporated and Tetra Tech.

Peer review:

The economic assessments were not peer reviewed nor were sections of the documents peer reviewed because they did not include novel methods or approaches.

Attachment 1: Scope of Final Rule

Excerpt from "Effluent Guidelines Aquatic Animal Production Industry Final Rule - Fact Sheet"
http://www.epa.gov/waterscience/guide/aquaculture/fs-final.htm#

The rule requires that all applicable facilities:

- Prevent discharge of drugs and pesticides that have been spilled and minimize discharges of excess feed.
- Regularly maintain production and wastewater treatment systems.
- Keep records on numbers and weights of animals, amounts of feed, and frequency of cleaning, inspections, maintenance, and repairs.
- Train staff to prevent and respond to spills and to properly operate and maintain production and wastewater treatment systems.
- Report the use of experimental animal drugs or drugs that are not used in accordance with label requirements.
- Report failure of or damage to a containment system.
- Develop, maintain, and certify a Best Management Practice plan that describes how the facility will meet the requirements.

The rule requires flow through and recirculating discharge facilities to minimize the discharge of solids such as uneaten feed, settled solids, and animal carcasses.

The rule requires open water system facilities to:

- Use active feed monitoring and management strategies to allow only the least possible uneaten feed to accumulate beneath the nets.
- Properly dispose of feed bags, packaging materials, waste rope, and netting.
- Limit as much as possible wastewater discharges resulting from the transport or harvest of the animals.
- Prevent the discharge of dead animals in the wastewater.

Attachment 2
Technologies Required by the Final Rule Compared with other options considered by EPA

Image below taken from final assessment, page 4-2

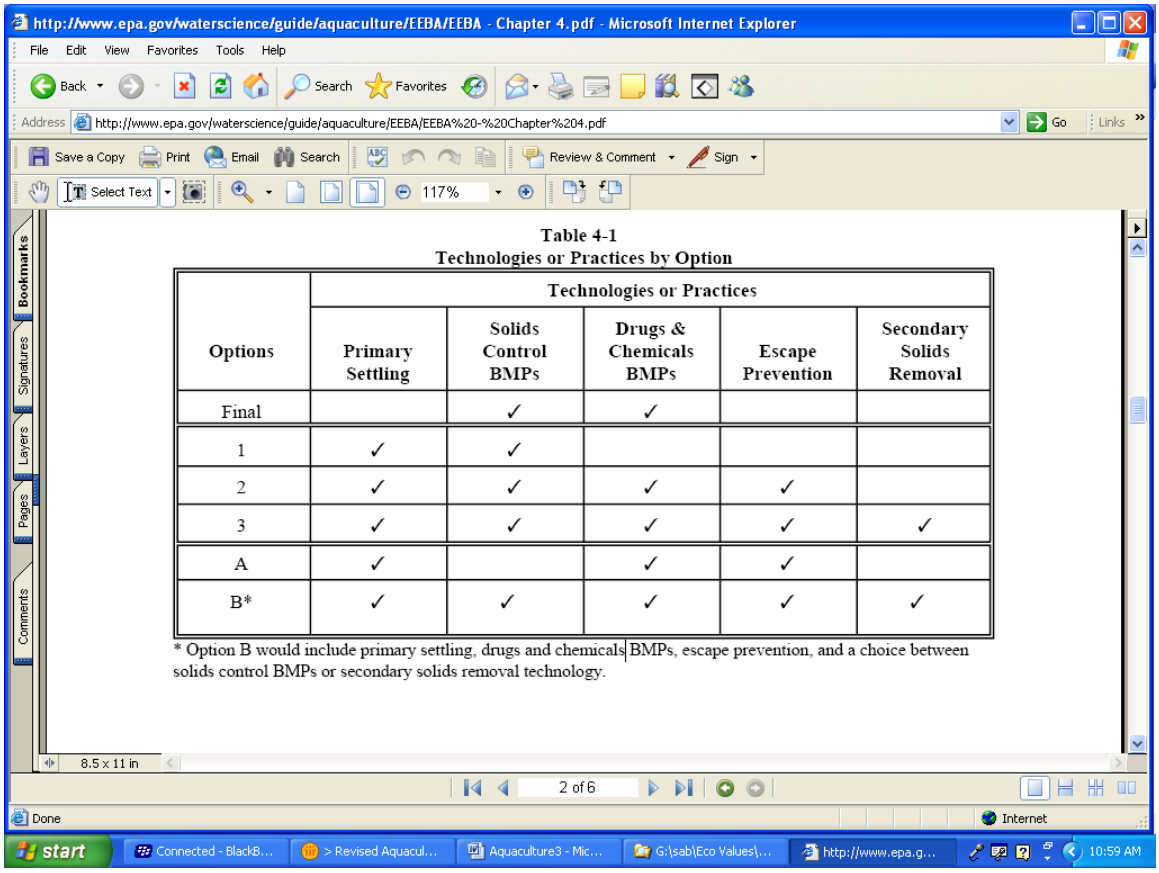

Table 4-1
Technologies or Practices by Option

Options	Technologies or Practices				
	Primary Settling	Solids Control BMPs	Drugs & Chemicals BMPs	Escape Prevention	Secondary Solids Removal
Final		✓	✓		
1	✓	✓			
2	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓
A	✓		✓	✓	
B*	✓	✓	✓	✓	✓

* Option B would include primary settling, drugs and chemicals BMPs, escape prevention, and a choice between solids control BMPs or secondary solids removal technology.

Appendix B: C-VPESS Subcommittee on Regional Decision Making Involving Partnerships

List of Subcommittee Members

Dr. Ann Bostrom, **Co-Lead,** Associate Professor, School of Public Policy, Georgia Institute of Technology, Atlanta, GA

Dr. James Boyd, Senior Fellow, Director, Energy & Natural Resources Division, Resources for the Future, Washington, DC

Dr. Dennis Grossman, Vice President for Science, Science Division, NatureServe, Arlington, VA

Dr. Louis F. Pitelka, Professor, Appalachian Laboratory, University of Maryland Center for Environmental Science, Frostburg, MD

Dr. Stephen Polasky, Co-Lead, Fesler-Lampert Professor of Ecological/Environmental Economics, Department of Applied Economics, University of Minnesota, St. Paul, MN

Dr. Paul G. Risser, Chancellor, Oklahoma State Regents for Higher Education, Oklahoma City, OK

Dr. Holmes Rolston, University Distinguished Professor, Department of Philosophy, Colorado State University, Fort Collins, CO

Dr. Joan Roughgarden, Professor, Biological Sciences and Evolutionary Biology, Stanford University, Stanford, CA

Dr. Barton H. (Buzz) Thompson, Jr., Robert E. Paradise Professor of Natural Resources Law and Director, Woods Institute for the Environment , Stanford University, Stanford, CA

Overview of Chicago Wilderness Source Example for C-VPESS Subcommittee on Valuation for Regional Decision Making Involving Partnerships

Valuation Issues: There are a number of valuation issues germane to C-VPESS that arise in the context of the Chicago Wilderness Source Example. What are the values from protecting greenspace in the Chicago region? How does the conservation of greenspace contribute to biodiversity protection? How does the conservation of greenspace contribute to other ecosystem services such as recreation, aesthetics and water quality? What are the values associated with biodiversity protection and with other ecosystem services? How can the values associated with the conservation of greenspace be compared with the values of other development options?

EPA Decision/Reason for Valuation:

The Chicago Wilderness consortium is an alliance of more than 180 public and private organizations that have as their common goals "to restore the region's natural communities to long term viability, enrich local residents' quality of life, and contribute to the preservation of global biodiversity." EPA Region V is a member of the Chicago Wilderness consortium, interested in implementing a Green Infrastructure Vision through Green Infrastructure Mapping, in order to protect biodiversity in the Chicago area and to contribute to the overall mission of EPA. US EPA has also previously sponsored the consortium, which is currently sponsored by both public and private entities, including other federal agencies.

In the final 2004 report for the Green Infrastructure Vision, the Chicago Wilderness sustainability team notes the importance of identifying "at the community/municipal scale opportunities for the identification and protection of local green infrastructure that is important to biodiversity." As the consortium moves forward, members, such as EPA Region V, and outside entities, such as local counties, will need information about the value of land purchases and other investments for biodiversity conservation efforts, both relative to other possible investments, as well as the relative value of specific efforts, for prioritization purposes, and to justify investments to their constituents where necessary.

The scope of the consortium's work is described in Attachment 1 (pages 1-4 of the Strategic plan, and the Executive Summary from the Biodiversity Recovery Plan, web link on page 5).

Authority for and Genesis of Decision-Making

Chicago Wilderness is a consortium of public and private groups. There is no specific authority or decision-maker that guides the consortium or that mandates that certain analyses be undertaken (such as cost-benefit analysis). Chicago Wilderness pursues objectives as defined by its members ("to restore the region's natural communities to long term viability, enrich local residents' quality of life, and contribute to the preservation of global biodiversity"). The group is well established and influential in the Chicago region,

as demonstrated by its membership as well as the support it receives from both public and private partners. Though not required, quantifying values associated with the conservation of greenspace could be helpful for Chicago Wilderness in meeting its own stated objectives and communicating its analysis with other groups and the general public.

Use of Cost-benefit Analysis and/or Cost-effectiveness Analysis

Neither EPA Regional offices nor the Chicago Wilderness are operating under any mandate to carry out cost-benefit analysis. The case could be made that the consortium has adopted the objective of sustaining biodiversity. Understanding the process by which Chicago Wilderness established its goals is worth examination. What methods did Chicago Wilderness use to assess member's values? How were values of members aggregated to form the objective of the consortium? Taking the stated goal as given, there may be limited scope for valuation and cost-benefit analysis. In this case, it may be more appropriate for decision-making and prioritization of green infrastructure projects to use cost-effectiveness analysis. Application of cost-effectiveness analysis would still require knowledge of how various decisions affected biodiversity and the costs of these decisions, but estimates of the value of biodiversity may not be required.

Nothing prevents EPA or other decision-makers in the consortium from considering cost-benefit analysis, or an analysis comparing costs to the values associated with different options as part of the entire technical analysis supporting a decision. Information in cost-benefit analysis or an analysis comparing costs to the values associated with different options, can be useful by decision makers, especially for controversial issues. Analysts can provide both formal monetized and non-monetized cost-benefit analyses, supplemented with narrative description of non-quantifiable values, to explain the benefits of different green infrastructure development options.

Decision-maker who will use analysis: Public and private decision makers affiliated with the consortium, including EPA Region V.

Other audiences for valuation information:

Other audiences include: Interested and affected parties (e.g., Chicago area landholders, trade associations, environmental groups, and the technical experts hired by these parties).

Status of Valuation Work for Chicago Wilderness and Chronology of Valuation Effort:

Decision/document	Date	Source/URL
Biodiversity Recovery Plan	1999 (Award from APA in 2001 for best plan)	http://www.chicagowilderness.org/pubprod/brp/index.cfm Executive summary available at http://www.chicagowilderness.org/pubprod/brppdf/CWBRP_chapter1.pdf
Chicago Wilderness Green Infrastructure Vision	Final report, March 2004	http://www.nipc.org/environment/sustainable/biodiversity/greeninfrastructure/Green%20Infrastructure%20Vision%20Final%20Report.pdf
Green Infrastructure Mapping		http://www.greenmapping.org/
A Strategic Plan for the Chicago Wilderness Consortium (See attachment 1 for Introduction)	17 March 2005	http://yosemite.epa.gov/SAB/sabcvpess.nsf/06347c93513b181385256dbf00541478/72c1b26a9d2087568525713f005832e1!OpenDocument
Chicago Wilderness Regional Monitoring Workshop Final report, by Geoffrey Levin	February, 2005	http://yosemite.epa.gov/SAB/sabcvpess.nsf/06347c93513b181385256dbf00541478/8c33ee9115d706e68525713f005784e6!OpenDocument
Center for Neighborhood Technology (CNT) – green infrastructure valuation calculator	2006 (?)	http://greenvalues.cnt.org/calculator

The web page for the Chicago Wilderness (http://www.chicagowilderness.org/) contains a more complete chronology and links to many of these relevant documents, including the Biodiversity Recovery Plan.

Activities and Approaches in Other EPA Regions

EPA Regional offices seek opportunities to work with public and private partners to protect biodiversity and greenspace and to work on other ecological issues. Summarized below are analytical efforts underway in other regions to support goals that parallel Region V's partnership effort with Chicago Wilderness and information about two previous SAB reviews of critical ecosystem efforts.

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Title	**Abstract**	**Web-link**
Environmental Accounting Using Emergy: Evaluation of the State of West Virginia EPA/600/R-05/006, March 2005	Working with Region 3, EPA ORD has published an analysis of environmental accounting using emergy approaches for the State of West Virginia	http://www.epa.gov/NHEERL/publications/files/wvevaluationposted.pdf
Hoctor, T., G. Lewis, et al. (2004). *Protecting Critical Ecosystems: Current EPA Regional Activities and Future Agency Opportunities*, Unpublished Report.	Unpublished 2004 Report funded by EPA's Office of Policy, Economics and Innovations and developed by Tom Hoctor, Ph.D. et al, Department of Landscape Architecture, University of Florida. Document inventoried current EPA Regional critical ecosystem assessments and other relevant projects to identify available data, methods, analytical tools, and gaps in available information. *Examined:* Region 2— NEPAssist internet GIS tool for impact assessment Region 4— Southeastern Ecological Framework (SEF) Region 5— Critical Ecosystems Assessment Model (CrEAM) Region 6— GIS Screening Tool (GISST) Region 7— Synoptic assessment of wetland function model Region 8— Environmental Monitoring and Resource (EMAP) water resources assessment Region 10— Rapid Access INformation System (RAINS)	http://yosemite.epa.gov/SAB/sabcvpess.nsf/06347c93513b181385256dbf00541478/b85f9626453f046d8525713f0056ac04!OpenDocument
EPA-SAB-05-011 *Review of the EPA Region 5 Critical Ecosystem Assessment Model (CrEAM*	An SAB panel reviews the methodology and conceptual framework used Region 5's Critical Ecosystem Assessment Model (CrEAM). The CrEAM was developed to identify ecologically significant areas in Region 5 in order to quantify and track ecosystem quality, target areas for protection, prioritize protection activities, and provide information to conduct National Environmental Policy Act reviews.	http://www.epa.gov/sab/pdf/cream_sab-05-011.pdf
EPA-SAB-EPEC-LTR-02-002 *Review of the Southeastern Ecological Framework: An EPA Science*	An SAB panel reviews the Southeastern Ecological Framework (SEF), a decision support system intended to identify remaining natural areas in the	http://www.epa.gov/sab/pdf/epecl02002.pdf

Advisory Board Report	southeastern U.S. of highest value for conserving regional biodiversity. Developed	

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Other Aspects of the Analytical Process

Data constraints:

The Green Mapping project includes over 200 data layers, many of which focus on land properties per se, but also endangered species and other attributes of the areas in the region. The CW recognizes the limitations in its data with regard to monitoring or characterizing biodiversity, as described in the Regional Monitoring Workshop final report and the Levin proposal for monitoring. While there are numerous relevant databases in addition to the green mapping project, many of these are not entirely accessible, and the data are in various formats and locations.

Resource constraints:

A list of member organizations of Chicago Wilderness can be found at:
http://www.chicagowilderness.org/coalition/members/index.cfm

The Center for Neighborhood Technology plays a critical role in the current green mapping efforts. Consortium members also contribute in various ways. Among the richest resources for the CW is its membership and history of careful attention to process.

Peer review:

While there is a 'calculator' that has just been developed by the Center for Neighborhood Technology, it has just been released and has not been peer reviewed.

Attachment 1:
Part A:
Opening section of A Strategic Plan for the Chicago Wilderness Consortium

Introduction

Using the *Biodiversity Recovery Plan*, the Chicago Wilderness consortium has developed a strategic plan. While each member will contribute towards achieving the vision for the region according to its own mission and priorities, there is a unique niche and role that members can play when acting together as a consortium. This strategic plan guides the work of the consortium as a whole[9].

The strategic plan has a number of component parts, which are laid out in this document. In addition, there are two companion pieces. One companion document is A Chicago Wilderness Handbook: How the consortium works and how to get involved, which describes the structure of the organization as well as the processes it uses to operate. The Handbook also contains basic information about membership in Chicago Wilderness. The second companion piece is The Five Year Project Pipeline. The Five Year Project Pipeline is written as a separate document as it will be a living document – updated every year, and continually growing as new ideas emerge from Chicago Wilderness collaborative processes.

This document contains the following components:

- the vision
- the mission
- the basic beliefs
- the strategic foundations
- long-term objectives
- themes (strategic areas of work)
- short-term objectives.

The **vision** describes our desired future state for the Chicago Wilderness region. The **mission** describes how Chicago Wilderness as a consortium will work to achieve this vision, while the **basic beliefs** outline principles to which all Chicago Wilderness members agree and work. The **strategic foundations** outline the areas in which and strategies through which Chicago Wilderness will work. The **long-term objectives** outline the work that we as a consortium hope to achieve in order to bring about our vision. A number of strategies will be needed to achieve each of the long-term objectives. To organize thinking and logical order for implementing strategies, they have been grouped into strategic themes. The **themes** are groupings of strategies each of which needs to be undertaken (or has already been completed) to progress toward fulfilling the long term objective. For each theme, the consortium has identified **short term objectives**, which may also be considered as measures of success, as these short-

[9] This project was generously supported by the John D. and Catherine T. MacArthur Foundation

term objectives are end states that the consortium plans to achieve by a specified date. Collectively, these short-term objectives will build upon one another to achieve the long term objectives.

Chicago Wilderness implements its work through collaborative projects. Each collaborative project undertaken by the consortium will work towards achieving a short-term objective, and thereby a long-term objective. As project ideas are formulated, they will be captured along with the short-term objectives in the Five Year Project Pipeline. The Five Year Project Pipeline will be a living document, because the both the short-term objectives and the projects in the pipeline will be updated each year to reflect what has been accomplished and what the next steps are. In this way, the consortium will be proactive and always have a plan that sets direction for the next five years.

Process to develop the Strategic Plan

In December 2003, the Chicago Wilderness Steering Committee initiated a strategic planning process. Since then, Chicago Wilderness (CW) has invested a significant amount of time, talent, and hard work to create this strategic plan. The plan's purpose is to provide a strategic framework, focus, and direction to the consortium's work for the next 10 – 15 years, as well as identify the operational structures, processes, and programs needed to support the consortium's leading edge, collaborative model.

The Steering Committee formed a core team to represent CW's membership during the planning process. The process was facilitated by Parks Consulting Group (PCG). PCG worked with the core team to customize a planning model and approach that would meet CW's unique needs. The model reflects the building blocks of the strategy and the iterative, inclusive approach used throughout.

In the first stage of the process, the core team gathered as much information and input as possible, from interviews, team meetings, a review of identified strengths, weaknesses, opportunities, and threats (also known as a SWOT analysis), a survey of all consortium members, and a review of CW literature and best practices. Using this information, the core team then discussed the issues and developed drafts that were reviewed at various points with subject matter experts, the Steering Committee, the Executive Council and other CW members. Feedback from the drafts was used to refine and prioritize the ideas. The resulting strategy is presented here and provides focus and direction for what the CW members want to accomplish.

Vision for the Chicago Wilderness Region

We envision a future:

- Where accessible, interconnected, restored and healthy ecosystems contribute to economic vitality and quality of life for all residents in the Chicago metropolitan area;
- Where the region's abundant open spaces and natural communities are actively protected, restored, and managed to ecological health;
- Where people appreciate, take pride in, and provide support to our native ecosystems; and
- Where the resulting culture is one of conservation and stewardship of nature.

Mission for the Chicago Wilderness Consortium

To realize this vision, Chicago Wilderness is a consortium of organizations that champions biodiversity and its contribution to the quality of life in the urban, suburban, and rural areas of the Chicago Metropolitan region. Together, we work across the region to:

- Raise awareness and knowledge about the biodiversity and value of nature in our region, our neighborhoods, our workplaces, our schools, and our homes through formal and informal education.
- Increase and diversify public participation and environmental stewardship.
- Build alliances among the diverse constituencies throughout the Chicago region to foster a sustainable relationship with nature.
- Facilitate applied natural and social science research, best practices development, and information sharing.
- Generate broad-based public and private support and attract resources to achieve our goals.

Basic Beliefs of all Chicago Wilderness members

We believe that:

- People's lives are improved by a connection with nature.
- Healthy ecosystems and biodiversity are critical to a thriving, vital economy.
- The natural communities in our region, some globally rare, need to be actively managed and conserved.
- Our work is regional in nature and can transcend political and socioeconomic boundaries.
- The decisions that we make are based on the best scientifically defensible information and research programs available.
- Regional collaboration is the most effective way to achieve our goals.

Long-term Objectives

In order to fulfill its mission and work towards its vision, the Chicago Wilderness consortium has identified the following long-term objectives. Each long-term objective encompasses many concepts and ideas. As such, each objective is explained in detail on the following pages. In addition, strategic areas of work and ways to measure progress for each objective are given. In summary, the long-term objectives for the Chicago Wilderness consortium are:

- The Chicago Wilderness consortium and its partners conserve the region's biodiversity by knowing and understanding the status and trends of biodiversity; soil, water, and air quality; and the biological, social, and economic factors that affect these resources.
- People in the region understand and value the importance of biodiversity, which is reflected in individual and institutional behaviors and decisions.
- The amount and quality of public and privately owned land and water in the region are adequate to recover and sustain regional biodiversity.
- Strategies used to meet these long-term objectives are best practices for conservation management that are the product of adaptive management as well as verification by on-going research programs in both the natural and social sciences.
- The CW consortium, its partners, and the region are successful models of collaboration and conservation action.
- Regional resources (financial and other) are sufficient for accomplishing these objectives.

Appendix C: C-VPESS Subcommittee on Valuation for Local Decision Making

List of Subcommittee Members

Dr. Joseph Arvai, Director, Community, Agriculture, Resource and Recreation Studies (CARRS), Michigan State University, East Lansing, MI

Dr. Gregory Biddinger, **Co-Lead,** Environmental Programs Coordinator, ExxonMobil Biomedical Sciences, Inc, Houston, TX

Dr. Terry Daniel, Professor of Psychology and Natural Resources, Department of Psychology, Environmental Perception Laboratory, University of Arizona, Tucson, AZ

Dr. Geoffrey Heal, **Co-Lead,** Paul Garrett Professor of Public Policy and Business Responsibility, Columbia Business School, Columbia University, New York, NY

Dr. Mark Sagoff, Senior Research Scholar, Institute for Philosophy and Public Policy, School of Public Affairs, University of Maryland, College Park, MD

Dr. Kathleen Segerson, Professor, Department of Economics, University of Connecticut, Storrs, CT

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[i] Trails.com at http://www..com/tcatalog_trail.asp?trailid=XFA040-018
[ii] http://www.epa.gov/superfund/programs/recycle/impacts/pdfs/dupage.pdf